THE BALLAST WATER CONTROL ACT

HEARING

BEFORE THE

 ON MERCHANT MARINE
FISHERIES MANAGEMENT
AND
COAST GUARD AND NAVIGATION
OF THE

COMMITTEE ON MERCHANT MARINE AND FISHERIES HOUSE OF REPRESENTATIVES

ONE HUNDRED THIRD CONGRESS

FIRST SESSION

ON

H.R. 3360

A BILL TO DIRECT THE SECRETARY OF TRANSPORTATION TO DEMONSTRATE ON VESSELS BALLAST WATER MANAGEMENT TECHNOLOGIES AND PRACTICES, INCLUDING VESSEL MODIFICATION AND DESIGN, THAT WILL PREVENT AQUATIC NONINDIGENOUS SPECIES FROM BEING INTRODUCED AND SPREAD IN UNITED STATES WATERS

OCTOBER 27, 1993

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THE BALLAST WATER CONTROL ACT

WEDNESDAY, OCTOBER 27, 1993

HOUSE OF REPRESENTATIVES, SUBCOMMITTEE ON MERCHANT MARINE, SUBCOMMITTEE ON FISHERIES MANAGEMENT, AND SUBCOMMITTEE ON COAST GUARD AND NAVIGATION, COMMITTEE ON MERCHANT MARINE AND FISHERIES,

Washington, DC.

The Subcommittees met, pursuant to call, at 10:05 a.m., in room 1334, Longworth House Office Building, Hon. William O. Lipinski (Chairman of the Subcommittee on Merchant Marine) presiding.

Present: Representatives Lipinski, Taylor and Kingston; Subcommittee on Merchant Marine.

Representatives Manton, Hughes, Pallone, Coble, Ravenel, Kingston, and Torkildsen; Subcommittee on Fisheries Management.

Representative Hockbrueckner; Subcommittee on Coast Guard and Navigation.

Staff Present: Keith Lesnick, Staff Director; Randy Morris, Legislative Clerk; Natalie Hidalgo, Professional Staff; David Honness, Professional Staff; Shelby Mertes, Staff Aide; Lori Rosa, Professional Staff; Vicki Credle, NOAA Detailee; Carol Alvarado, Legislative Assistant to Mr. Green; Lee Crockett, Professional Staff; Sue Waldron, Press Assistant; Cynthia M. Wilkinson, Minority Chief Counsel; Kip Robinson, Minority Counsel; Margherita Woods, Staff Assistant; Rebecca Dye, Minority Counsel.

STATEMENT OF HON. WILLIAM O. LIPINSKI, A U.S. REPRESENTATIVE FROM ILLINOIS, AND CHAIRMAN, SUBCOMMITTEE ON MERCHANT MARINE

Mr. LIPINSKI. Good morning, ladies and gentlemen, boys and girls and children of all ages, I want to welcome you here this morning.

Today, we are going to conduct a joint hearing with the Subcommittees on Merchant Marine, Coast Guard and Navigation and Fisheries Management. I would like to take this opportunity to thank Chairman Tauzin and Chairman Manton for agreeing to hold this session. Those gentlemen should be here in very short order.

One of the most difficult problems plaguing the delicate ecosystem of our inland waterways and coasts is the introduction and spread of aquatic nuisances such as the zebra mussel, sea lamprey and river ruffe. The zebra mussel and sea lamprey have taken a tremendous toll on the well-being of the Great Lakes and the ruffe threatens to do the same. As caretakers of the world's largest fresh surface water system, we have a responsibility to ensure that the

Great Lakes and other marine environments are protected from further introduction of aquatic nuisances. We must find a workable, permanent solution to the transfer of aquatic nuisances through ballast water.

The information gathered today is a step toward finding a long-term practical solution to the spread of aquatic nuisances. I have introduced legislation to explore promising ballast management technologies. This legislation will bring together aquatic biologists, marine architects, shipping companies, and Federal agencies in a demonstration program incorporating ballast management technologies and practices into shipping operations in an effort to eliminate the threat of aquatic invasions.

Congress and the Administration must take the lead to forge a comprehensive solution to this problem. I am encouraged by the shipping industry's voluntary efforts to help stem the tide of aquatic nuisance invasions. The public and private sectors must once again come together to find a real world solution to a problem threatening our environment.

I would just like to say, too, that we refer to it as the Great Lakes, but being from the City of Chicago, I have always referred to Lake Michigan as Lake Chicago, and I think I am seriously considering expanding that to the entire Great Lakes, we will just call it Great Chicago and we will all be better off.

I now recognize Mr. Kingston for his opening remarks.

STATEMENT OF HON. JACK KINGSTON, A U.S. REPRESENTATIVE FROM GEORGIA

Mr. KINGSTON. Thank you, Mr. Chairman. If you are going to introduce a bill to that effect, I will be glad to cosponsor it since I don't think my constituents really worry about it.

Mr. LIPINSKI. I am really happy to hear that and if I can do you a favor sometime, please let me know.

Mr. KINGSTON. I am glad you are having this hearing, Mr. Chairman, and I have no opening statement except that I am interested in it and I am looking forward to hearing the testimony.

Mr. LIPINSKI. Thank you very much. Mr. Coble, how are you this morning.

Mr. COBLE. Mr. Chairman, how are you doing this morning?

Mr. LIPINSKI. Just fine, thank you, and it is a pleasure to have you here. Do you have any opening statement by any chance at the present time.

Mr. COBLE. Just a few short comments, Mr. Chairman.

Mr. LIPINSKI. Certainly, the floor is yours.

STATEMENT OF HON. HOWARD COBLE, A U.S. REPRESENTATIVE FROM NORTH CAROLINA

Mr. COBLE. I look forward to studying your recently introduced bill which calls for the Coast Guard to study technologies which may prevent vessel ballast water from inadvertently introducing nonindigenous species, such as the harmful zebra mussel, into United States waters.

The recently released study from the Office of Technology Assessment about harmful nonindigenous species reports that these

species cost our country hundreds of millions, and I have been told, Mr. Chairman, even billions of dollars a year.

We clearly need to find ways to combat the continued introduction of unwanted species in our country, and I look forward to hearing the views of the witnesses before us today about this attempt to at least control this problems, and I thank the Chairman.

Mr. LIPINSKI. Thank you very much.

Mr. Torkildsen, do you have an opening statement.

Mr. TORKILDSEN. No, Mr. Chairman. Thank you, though.

Mr. LIPINSKI. Thank you. Thank you for your attendance here.

[The statements of Mr. Manton and Mr. Fields follow:]

STATEMENT OF HON. THOMAS J. MANTON, A U.S. REPRESENTATIVE FROM NEW YORK, AND CHAIRMAN, SUBCOMMITTEE ON FISHERIES MANAGEMENT

Good morning. About 10 years ago, a band of tiny hard-shelled immigrants arrived in the United States and made their home in Lake St. Clair. No INS agent visited the colonies of these fingernail-sized mollusks, and they didn't check in at Ellis Island. But they did not go unnoticed for long. Suddenly, these bivalves were turning up in the Hudson River, clogging pipes as they drove out native species. Now, from the Great Lakes to the Chesapeake and on down the Mississippi, the zebra mussels are making enemies as they grow and multiply. In fact, zebra mussels have a bad name in 18 states. The Office of Technology Assessment estimates the cost of adaptive measures to control these pests will be about $4 billion; and in the end, we will have only slowed the spread of these creatures, we will not have destroyed them.

But though many of us are all too familiar with the zebra mussel problem, they are only one type of aquatic nuisance. Other species such as the Sea Lamprey, the Asian Clam, and now the European River Ruffe have invaded the U.S. in the same manner as the mussels—primarily through the transfer of ships' ballast water. Promising technologies to cleanse ballast water give us hope to deter the spread of these foreign creatures.

I must commend the Great Lakes Task Force for their efforts in developing an appropriate response to these aquatic nuisances. Also, I recognize the initiative of Chairman Lipinski for sponsoring this legislation before us today. Hopefully, we can continue to work to arrest these invaders already on our shores and to prevent the introduction of new species.

STATEMENT OF HON. JACK FIELDS, A U.S. REPRESENTATIVE FROM TEXAS, AND RANKING MINORITY MEMBER, COMMITTEE ON MERCHANT MARINE AND FISHERIES

Mr. Chairman, the problems created by aquatic nuisance species first came to light in the mid-1980's in the Great Lakes. The Aquatic Nuisance Prevention and Control Act of 1990 was enacted to respond to this problem. Under this Act, the Coast Guard established voluntary ballast water exchange requirements for the Great Lakes that became mandatory on April 8, 1993. Alternatives to current ballast water exchange practices are also authorized under the Act.

I will be interested in the testimony from today's witnesses on the need for Federal expenditures to test alternative technologies for ballast water exchange. If a specific alternative technology is indeed promising, I think that private dollars should be available to fund studies and tests to develop the technology. I do agree, however, that we should encourage private groups, including vessel owners, to adopt an active role in aquatic non-indigenous species prevention and control, to prevent the spread of these species to waterways across the nation.

Thank you, Mr. Chairman.

Mr. LIPINSKI. I will now introduce the panelists here. We have Ms. Kate Kimball, who is the Deputy Assistant Secretary for Oceans and Atmospheres. I understand she is accompanied by Mr. Gary B. Edwards, Assistant Director for Fisheries, U.S. Fish and Wildlife Service, Cochair of the Aquatic Nuisance Species Task Force, and they are from the National Oceanic and Atmospheric Administration. We have Dr. Jim Carlton, from Williams College,

Mystic Seaport, Director, Maritime Studies Program. We have Mr. Bruce Shupp from the New York Department of Environmental Conservation. He is the Chief of the Bureau of Fisheries, Division of Fish and Wildlife. Mr. George Ryan, Lake Carriers Association, he is the President of that organization. We have Captain Michael J. Donohoe, U.S. Coast Guard, Chief, Marine Environmental Protection Division, and from the Maritime Administration, we have Mr. Marc P. Lasky, Chief, Division of Naval Architecture, Office of the Associate Administrator for Shipbuilding and Ship Operations.

Welcome to each and every one of you. I sincerely appreciate your all being here this morning. We are going to be starting with Ms. Kimball and her testimony, and then we will go to Dr. Carlton, Mr. Shupp, Mr. Ryan, Captain Donohoe, and Mr. Lasky.

Ms. Kimball, the floor is yours.

STATEMENT OF KATE KIMBALL, DEPUTY ASSISTANT SECRETARY FOR OCEANS AND ATMOSPHERE, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, ACCOMPANIED BY GARY B. EDWARDS, ASSISTANT DIRECTOR FOR FISHERIES, U.S. FISH AND WILDLIFE SERVICE, COCHAIR, AQUATIC NUISANCE SPECIES TASK FORCE

Ms. KIMBALL. Thank you, Mr. Chairman. I am Kate Kimball, Deputy Assistant Secretary for Oceans and Atmosphere. I appreciate this opportunity to present the goals and accomplishments of the Aquatic Nuisance Species Task Force and NOAA's efforts as cochair of that task force.

As you know, the task force was established under the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990. The task force's primary goals are to prevent introductions, control impacts, disseminate information and coordinate research.

Due to current fiscal conditions, sufficient funds authorized under the act have not been appropriated. Notwithstanding this limitation, the task force has moved forward to fulfill the mandates of the act. We are proud of our achievements to date. I will begin by describing the task force's efforts related to the ballast water control program and then turn to the aquatic nuisance species program.

As part of the national ballast water control program, the task force is mandated to conduct ballast exchange and biological studies. Because funds were not available to initiate the studies, the task force has been unable to meet the statutory deadlines but we have kept Congress informed of our progress to date.

This summer funds were identified for both studies. The ballast exchange studies will be initiated with EPA funds in the spring of 1994 and conducted at NOAA's Great Lakes Environmental Research Lab. Additional funds from NOAA and the Fish and Wildlife Service will enable the study to be completed by June of 1995.

The biological study was initiated with the Fish and Wildlife Service funds in July 1993. In 1994, case studies of impacts on Florida and the San Francisco Bay delta region will be assessed. Additional funds from NOAA and EPA will be used to complete the case studies by September 1994.

To facilitate carrying out the ballast water control program, the Act encourages the task force to enter into negotiations and cooperative efforts with foreign countries. In July of this year, the International Maritime Organization's Marine Environmental Protection Committee initiated discussion of harmful marine organisms in ballast water. At the Coast Guard's request, NOAA submitted a paper on the task force's activities and was represented on the U.S. delegation. The committee recommended a formal working group be convened on the issue to consider further developing IMO's voluntary ballast water guidelines as the basis for an annex to the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78). The task force will continue to work with IMO on this important issue.

The committee also recommended an international ballast water symposium be convened. The Coast Guard has approached NOAA regarding sponsorship. We would like to carry out this symposium as a task force effort, and are working with Australia regarding dual sponsorship.

In April of this year, NOAA sponsored an international workshop to identify appropriate management and research activities for estuarine and marine areas. Five countries were represented. It was an excellent forum for assessing our current understanding of the global effects of exotic species. Workshop results and an overview of task force activities are being presented to the International Conference on the Environmental Management of Enclosed Coastal Seas.

In addition to the ballast water program, the Act requires development of an aquatic nuisance species program. The program has completed public review and is expected to be approved at the task force's November meeting. The task force is using the control process outlined in the program to deal with introduction of ruffe to the Great Lakes. The task force determined a study was warranted of ruffe and convened a meeting to develop a control program. Upon completion of the program's environmental assessment, the program will then be released for public review.

In addition to control, research is the key element of the ANS program. The Act requires the task force to establish a protocol for evaluating research. The protocol was issued as an interim document in September 1992 and will be modified as new data become available.

NOAA and EPA funded a workshop at NOAA's Great Lakes lab to assist the task force protocol committee in evaluating zebra mussel research protocols. Assistance and education are additional elements of the program. NOAA's National Sea Grant College Program is providing extensive educational and technical assistance through its State offices and marine advisory services.

The zebra mussel information clearinghouse, with which you may be familiar, is a project of New York's Sea Grant. Sea Grant's network of researchers and extension agents are developing control methods and communicating these results to local communities. The Fish and Wildlife Service has also been developing educational materials in cooperation with State agencies.

The final program element is the zebra mussel demonstration program. The Army Corps of Engineers is actively engaged in re-

search and development for the environmentally sound control of zebra mussels at public facilities.

In addition to the program, the task force was to convene a panel of representatives to help the task force implement the Great Lakes' provisions of the Act. The Great Lakes panel was formally convened in November 1991. The panel provides a crucial link and has been an instrumental force in the basin.

The Act also establishes an aquatic nuisance species management plans and grants program whereby States can receive partial funding for management plans. The State of New York submitted a draft plan to the task force for review. We have also completed the intentional introduction policy review that is required under the Act.

A final provision of the Act is development of a brown tree snake control program. The committee has been convened and is currently developing a control program.

In closing, the waters of the United States are a resource of immeasurable economic, environmental, and aesthetic value. The task force is committed to protecting our waters from the threat of exotic species.

Mr. Chairman, thank you for the opportunity to testify.

Mr. LIPINSKI. Thank you very much for your testimony.

And I would like to state at this time that Ms. Kimball's testimony is a lot more extensive than what she has stated for us here verbally, and we will be incorporating her entire testimony into the record of these proceedings. We will do that now, if there are no objections, and I am sure there are no objections from anyone. The same will be true for everyone else's testimony. We will incorporate your full testimony as part of the record, even though you will be summarizing only a small portion of it.

[The statement of Ms. Kimball may be found at end of hearing.]

Mr. LIPINSKI. Our next witness will be Dr. James T. Carlton. Dr. Carlton.

STATEMENT OF JAMES CARLTON, DIRECTOR, MARITIME STUDIES PROGRAM, WILLIAMS COLLEGE, MYSTIC SEAPORT

Mr. CARLTON. Thank you, Mr. Chairman. I am the principal investigator of the shipping study mandated under the Nonindigenous Aquatic Nuisance Species Act on the role of shipping in introducing exotic species to U.S. waters.

In the Coast Guard-funded shipping study, we estimated how much ballast water is arriving and where it comes from, the risk it poses, and what to do about it. Every hour that we speak this morning, over one and a half million gallons of ballast water containing alien aquatic animals and plants from all over the world are released into U.S. waters.

A few miles from this room in the past several weeks we have found ships releasing in the Chesapeake Bay fish from Liverpool and Israel, crabs from Korea, and a great variety of other marine life from Spain, Belgium, Egypt and Panama.

In the sea grant-funded study in Oregon, we found representatives of every major group of aquatic organisms in seawater ballast. And with your permission, I would like to enter into the record an

important paper published in Science three months ago on this study.

In the shipping study we found that while records are kept of the importation into this country of exotic land animals and plants, there are no records kept by any Federal agency of the amounts and sources of ballast water released in the United States—the major vector for the introduction of exotic aquatic animals and plants into this country.

What have we seen since the zebra mussel appeared in the Great Lakes in 1988? The gates for our marine coasts remained open and so the flood continued. Cholera appeared in Mobile Bay, Alabama, due to ballast water release; Japanese crabs have been found in New Jersey and have now made their way up to Cape Cod and will soon invade the Delaware and Chesapeake Bays. Carnivorous New Zealand sea slugs were reported this summer in San Francisco Bay eating their way through the clam populations. Russian jelly fish appeared this spring in Petaluma, California.

In the past few years a new aggressive European sea squirt has appeared in fouling communities in Massachusetts and Connecticut. New red tides and brown tides continue to appear on every coast. From the Columbia River to Los Angeles and Long Beach harbors, to the New Hampshire and Maine coasts, and to the jetties of Port Aransas, Texas, new invasions have poured in and they continue to pour in.

At any moment, other sites can become new invasion hot spots. Ports receiving huge amounts of ballast water include Houston and Galveston, New York and Norfolk, while New Orleans ranks as the number one U.S. port in terms of ballast discharged. In the 1990's, Long Island Sound, Chesapeake Bay, the Gulf of Mexico, including the New Orleans Delta, are all thus additional high profile sites facing risk of new invasions.

It is critical to emphasize that no coastal sites, however, are immune to invasions. The lesson of the zebra mussel teaches us that everything that could be here by now is not here by now.

There are things that can be done. They are not easy. They are not simple. One cannot, quote, just, unquote, heat the water or ultraviolet the water or filter the water. For most ships, at most times, these options simply do not exist without major refitting, nor do we know their effectiveness.

Ballast exchange, the release of original ballast water and the uptake of new ballast water in mid ocean is a necessary critical procedure, but there are many operational problems with such exchanges and evidence indicates that exchange is not efficient enough to protect America's salt water coasts.

It is now absolutely critical to undertake field trials of the promising technologies and other management options identified in the shipping study; to undertake studies of vessel retrofit and to undertake studies of new vessel design. The ghost of Christmas future surely includes new zebra mussels if we do not move forward with ballast control.

Exotic species threaten every aspect of our economy, our lives, and the environment. A single species can cause billions of dollars in damage, destroy entire economies, have critical effects on biodiversity, and push endangered species over the brink into extinc-

tion, and such a species, in theory, could have been released into the Chesapeake Bay this morning.

Over 15 billion gallons of ballast water are released into this country every year. At any one moment, at this very moment, literally thousands of species are in motion around the world on a biological conveyor belt that knows no precedence. This is ecological roulette in its highest form.

With the willingness and concern of the shipping industry, members of which supported the shipping study from its inception, and with their generous cooperation, which I believe we have, we can profoundly decrease the rate of exotic invasions. Thank you.

Mr. LIPINSKI. Thank you very much, Doctor.

[The statement of Mr. Carlton may be found at end of hearing.]

Mr. LIPINSKI. Our next witness will be—how do you pronounce your last name?

Mr. SHUPP. Shupp, Mr. Chairman.

Mr. LIPINSKI. Mr. Shupp. I was pretty close.

Mr. SHUPP. Close.

Mr. LIPINSKI. Bruce, you have the floor.

STATEMENT OF BRUCE D. SHUPP, CHIEF, BUREAU OF FISHERIES, DIVISION OF FISH AND WILDLIFE, NEW YORK DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Mr. SHUPP. Thank you.

Thank you, Mr. Chairman and members of the subcommittees. I am very pleased to testify today in support of the Ballast Control Act. My purpose is to illustrate and to strongly emphasize that preventing introduction of nonindigenous aquatic species is a much better strategy than attempting to control them once they are established.

During the last decade, two of the aquatic species that appeared in the Great Lakes' ecosystems will have, or may have, tremendous negative impacts. Those are zebra mussel and a small fish called ruffe. Zebra mussels were discovered in Lake St. Clair in just 1988. They are known to have displaced native mussels, clogged water intakes, fouled vessel hulls and motors, and affected navigation aids. But the least understood and potentially most damaging impact from zebra mussels is the shift of energy from the mid water areas of the lakes to the bottom environment.

If this biological productivity of the mid water area significantly declines, many of the desirable fishes will also decline with the potential economic loss of several billion dollars annually. There are scientists that predict such a problem.

Over the next decade, the cost to deal with just the physical and engineering problems associated with zebra mussels are estimated at from $3 billion to $8 billion, depending on whose estimates you use. These are not costs for controlling the organism. We are not controlling zebra mussels. At best, we are slowing expansion of their range as we adapt as a society to them.

The ruffe, a small fish of the European perch family, was first found in only 1987 in the Duluth Harbor of western Lake Superior. Its ultimate dispersal from Lake Superior will mirror that of zebra mussels—virtually all of the United States east of the Rockies. As

ruffe numbers have expanded within Duluth Harbor, native fish species have declined. There are no species-specific controls for ruffe.

We certainly are not now in control of ruffe and we may never be in control of ruffe. The ruffe is another multibillion dollar annual insult to the fisheries of North America.

Probably the best example of our society's inability to control an unwanted species is the sea lamprey. While ballast water figures prominently in the introduction of zebra mussels and ruffe, the sea lamprey expanded from the Atlantic Ocean into the Great Lakes through the canal building era of the 19th Century. The sea lamprey is rather unique among aquatic nonindigenous nuisance species since its life cycle predisposes it to effective control. We can control sea lamprey.

Since 1955, the Great Lakes Fishery Commission has developed effective technologies to markedly reduce sea lamprey in most areas of the Great Lakes and there are new technologies that offer promise of even more effective control without using chemicals.

Despite these capabilities, sea lamprey control is only a partial success. Why? Because we have not been willing to invest adequate money in the control effort. There is no indication from either the U.S. or Canadian Governments that this attitude will change in the near future.

So the solution for dealing with the potential ecological and economic impacts from yet to be introduced nonindigenous species is not to base future national strategies on our ability to control them. Our record has not been impressive in that area.

As the Ballast Control Act recommends, we must expeditiously invest in research to find the best and safest methods for preventing introduction of new organisms through ballast discharge.

I thank you very much for letting us give our opinions.

Mr. LIPINSKI. Thank you very much.

[The statement of Mr. Shupp may be found at end of hearing.]

Mr. LIPINSKI. Our next witness will be Mr. George Ryan.

Mr. RYAN. Thank you, Mr. Chairman. Of course, as we know, Lake Michigan was really called Lake Illinois by the Indians, and those folks in Michigan must have done something to you that was really wrong.

Mr. LIPINSKI. Yes, I don't know if we can trust those people in Michigan or not. You have to watch them closely.

STATEMENT OF GEORGE J. RYAN, PRESIDENT, LAKE CARRIERS' ASSOCIATION

Mr. RYAN. Mr. Chairman, we are very pleased to share our experiences with ballast water management in the hopes that some of these experiences may help in the development of legislation to study the problems related to the introduction and the spread of nonindigenous nuisance species and then to help to evaluate and test the promising ballast management technologies and practices. We certainly support your legislative process.

As you already know, Lake Carriers' Association, in connection with many other maritime interests in the Great Lakes, instituted a voluntary ballast water management plan to control the spread

of the European river ruffe from its current habitat in western Lake Superior. We and our partners in this endeavor are, in the words of the U.S. Fish and Wildlife Service, quote, "the first maritime association in North America to propose a voluntary ballast water management strategy."

When we identified the problem that the ruffe presented, we responded as quickly and to the degree that current knowledge and technology allowed as well as what economics would allow. We did not cause the problem but we know that we are part of the solution to mitigate it.

I say we did not cause the problem. I think the committee is aware that we are in the inland water transportation system and that the water we carry as ballast is water that is already contained within the inland waters of the United States. If there is some nonindigenous species within that water, they were probably brought in from a salt water ship.

As you know, the ruffe is a very aggressive feeder and, as noted earlier, in just six years it is now the most abundant fish in the Duluth/Superior Harbor and unfortunately it is spreading east at 25 miles a year. And I have to agree with my colleague at this table that probably in time the ruffe will spread probably to all waters east of the Rockies, in time.

The voluntary water ballast water management plan instituted at the beginning of the 1993 navigation season is simple in its context and execution. It did not require any retrofitting of any of our vessels or any significant distortions in loading or trading patterns. It was an ideal set of circumstances since Duluth/Superior Harbor is primarily a loading port, so only in certain circumstances is it necessary for a vessel to take on ballast water in Duluth/Superior.

We believe that the U.S. Coast Guard's strategy, present regulations based on law for the Great Lakes, is and should be the first line of defense. We must do our best to keep nuisance nonindigenous species out of our inland waters. All of these nonindigenous species are certainly blind to flag. Whether they come in through Canadian waters, Mexican waters, or U.S. waters, they will eventually get into the inland waters of the United States. And once in those waters it is very difficult, if not impossible, to control the spread.

As mentioned earlier, Duluth/Superior was ideal. If those ruffe get into Lake Erie or Lake Michigan, ballast water management plans such as we have would not work and we would probably have to stop it. I think the committee is well aware that ballasting is an essential function of vessel safety. When a ship is not carrying cargo, it has to have ballast on board so that the ship will ride low enough in the water to maintain safe steerage, to have hull stress management, and the stability of the vessel.

And ballasting, as indicated by Dr. Carlton, takes on vast amounts of waters. The largest U.S. vessel that we operate on the lakes does carry 14.5 million gallons when it is light. Even on the smaller ships, we carry 2.5 to 5 million gallons. This water is pumped out as the ship is loaded, and if you pump it out too quickly, the ship will hog, sag or snap in half causing severe damage to the vessel. And when you do ballast exchange in open waters, you

have to be careful you do not stress that hull girder and break it and lose life.

Simply put, then, ballast water carriage and discharge into the navigable waters will have to take place as long as ships are carrying cargo to and from ports throughout the United States and the entire world. The entire commerce of the United States depends upon ballast water.

In addition to ballast water management control, there have been numerous other proposals to control the spread of the nonindigenous species, and certainly Dr. Carlton's study outlines them very well. I have noted some of them in my complete paper.

But many of these suggestions are quite impractical from an operational viewpoint given the volumes of water we are dealing with. Just imagine trying to handle optically or sonically or chemically or heating thermally the water in the volumes we are talking about.

A ballast water management study directed at the Great Lakes and other inland waterways will help fill that gap of knowledge that we have to minimize the spread of nuisance species once found in the system. I think the Coast Guard has proven very capable of managing such a study, as they have done in the past.

And the proposed legislation also calls for the identification of technologies and practices for demonstration. This must be done, and I would pledge that vessels in our membership would be available as test platforms, and personnel would be available to assist in that demonstration. We think the Maritime Administration is a very fine organization and could also manage that demonstration program.

Thank you very much.

Mr. LIPINSKI. Thank you, Mr. Ryan, for your testimony.

[The statement of Mr. Ryan may be found at end of hearing.]

Mr. LIPINSKI. Next we will hear from Captain Donohoe.

STATEMENT OF CAPTAIN MICHAEL J. DONOHOE, CHIEF, MARINE ENVIRONMENTAL PROTECTION DIVISION, U.S. COAST GUARD

Captain DONOHOE. Good morning, Mr. Chairman, and distinguished members of the subcommittees. Thank you for this opportunity to talk about a few of our activities on the important issue of ballast water management and the need for alternatives to reduce the future introduction of aquatic nuisance species.

I have prepared a formal statement which has been submitted for the record, and I would like to take a few moments to summarize that statement for you this morning.

On April 8, 1993, the Coast Guard published regulations that require ballast water management for ships which have operated outside the exclusive economic zone and are bound for a U.S. port in the Great Lakes. In concert with the regulations we established, we are conducting an educational program consisting of a Coast Guard-produced video and pamphlet on the problems of aquatic nuisance introduction. I brought a limited number of these tapes and pamphlets for distribution to each interested subcommittee member following the hearing.

In developing the regulations and those upcoming for the Hudson River, we recognize that scientific and safety issues of ballast water exchange suggest the need for alternative methods of ballast water management. From our earliest involvement with the nonindigenous aquatic nuisance issue, the Coast Guard believed this issue must be addressed both domestically and as an international effort.

Accordingly, we have used our leadership at the International Maritime Organization for the development of international ballast water standards such as the IMO voluntary ballast water management guide lines adopted in July of 1991. To facilitate this effort, we are a member of the IMO working group looking at ballast water management as a possible new annex to the MARPOL convention.

I think it is important to mention that we are leveraging existing U.S. Federal assets by inviting representatives of NOAA to attend the IMO working group and bring their scientific knowledge to this important effort.

While the Coast Guard has ballast water enforcement authority over vessels entering the Great Lakes, we have been actively involved in a nationwide effort to reduce the introduction of aquatic nuisance species and pathogens using education and the voluntary guidelines. As a member of the Aquatic Nuisance Species Task Force and a member of its committees, we are working with States who have expressed interest in ballast water management. Among these is California, with its requirement that vessels entering California ports use ballast water management practices.

As required by the Nonindigenous Aquatic Nuisance Prevention and Control Act, the Coast Guard conducted a shipping study to explore the impact of shipping on the introduction of ballast water into ports other than those in the Great Lakes. Under the direction of Dr. James Carlton, the report of this study identifies ports that may be at risk from aquatic nuisance species being transported by ballast water and recommends possible control options.

The Coast Guard believes that it is imperative that alternative management methods be developed and made available, and we support efforts to define the necessary scientific and technical parameters for such alternatives.

The Coast Guard has begun working through ASTM, a voluntary consensus standards organization, to assess the technical nature of the nonindigenous species problem and develop technical standards for addressing it. ASTM's work will help build a technical consensus for solving the ballast water management problem using research and assets provided by the government, industry, and other private and public sector organizations.

In summary, the Coast Guard stands ready to assist any agency or private group in exploring the development of effective ballast water alternatives. We are committed to being a full participant in the effort to prevent the introduction and spread of aquatic nuisance species into the waters of the United States.

This concludes my prepared remarks, and I would be happy to answer questions at any time. Thank you, Mr. Chairman.

Mr. LIPINSKI. Thank you, Captain Donohoe.

[The statement of Captain Donohoe may be found at end of hearing.]

Mr. LIPINSKI. And our last witness to testify this morning will be Marc P. Lasky. Mr. Lasky.

STATEMENT OF MARC P. LASKY, CHIEF, DIVISION OF NAVAL ARCHITECTURE, OFFICE OF THE ASSOCIATE ADMINISTRATOR FOR SHIPBUILDING AND SHIP OPERATIONS, MARITIME ADMINISTRATION

Mr. LASKY. Thank you, Mr. Chairman, and members of the subcommittee. I appreciate the invitation to testify on behalf of the Maritime Administration concerning the Ballast Water Control Act.

You have heard a lot of testimony on what the damage is, I won't go over that. I will say that the uncontrolled discharge of ballast water is a major international problem that can be expected to worsen and a satisfactory long-term solution to the problem is needed.

We especially recognize how important a solution is to this problem to the Great Lakes. The Maritime Administration supports the goals of this legislation, including further study and demonstration. In an effort to assist the Coast Guard in carrying out the requirements of this bill, we believe that concerned Federal agencies should cosponsor an assessment of various technologies available under development for the control and treatment of harmful aquatic organisms in ballast water. This assessment could be followed by a demonstration project of one or more of the promising technologies, as required by the bill.

MARAD could also assist the Coast Guard in cooperatively administering and providing technical expertise for one or more of any funded demonstrations required by the Ballast Control Act. I have several examples of how our agency already performs these functions.

We have a limited research and development fund, however. We currently make the best use of these by conducting a variety of small scale research programs in a broad area. We do this in cooperation with other Federal agencies and the private sector.

For example, one program I will mention is the maritime operational safety program, which is concerned with advanced vessel navigation and communication systems, and operational procedures and maintenance policies that enhance maritime safety. Projects under this program are selected jointly with the National Transportation Safety Board and the U.S. Coast Guard.

Another program of particular relevance in the R&D area is our small business innovation research program. This encourages small businesses to develop innovative solutions to government and industry problems.

Programs under the small business program address human factors, environmental protection, and improvements in terminal, cargo, and ship operations. These are just a couple of examples. This particular program is administered by the department's Volpe Center, in cooperation with the Coast Guard.

We have some other examples of where we apply engineering and technology to other programs. We have a lot of experience in the area of ship construction and ship operation, and we also have a good understanding of the shipping industry itself. We have prepared numerous ship designs for both new construction and conversion. This experience is germane to the implementation of a funded ballast water exchange demonstration project.

Our participation in such a demonstration would also help provide the interface between the scientific community and what we like to call the real world of the maritime industry. This interface would help ensure that the technologies selected as the most promising from a scientific point of view are workable and can be economically and efficiently used in the commercial merchant fleet.

Most recently in that guise, we have provided technical expertise to the Coast Guard in their effort to provide regulations required by the Oil Pollution Act of 1990. We worked with several other government agencies, most notably the Navy, in converting national defense reserve fleet container ships into auxiliary crane ships and offshore petroleum discharge systems, which are still actively being used. On an ad hoc basis, we are also assisting NOAA with their fleet replacement program.

We believe that this bill provides a realistic timeframe for the submission of required reports on the completion of the study and on the findings and recommendations resulting from a demonstration project. It is our understanding that the funds necessary for a scientific study and a demonstration project would need to be provided.

This concludes my statement and I would be very happy to answer any questions that you may have.

Mr. LIPINSKI. Thank you. And thanks to all of you for your testimony. I find it to be very interesting and informative.

[The statement of Mr. Lasky may be found at end of hearing.]

Mr. LIPINSKI. Are there any Members who arrived after we started testimony that have either a verbal or a written opening statement?

Mr. MANTON. Mr. Chairman, I ask unanimous consent my statement be inserted in the record at the appropriate place.

Mr. LIPINSKI. Without objection, so ordered.

Mr. COBLE. Mr. Chairman, I would like to submit Congressman Fields statement for the record, without objection.

Mr. LIPINSKI. Without objection, so ordered.

And now we will start the questioning of the members of the panel with the Co-Chairman of this hearing, Mr. Manton. Mr. Manton, the floor is yours.

Mr. MANTON. Thank you, Mr. Chairman.

Captain Donohoe, how soon can we expect to receive the results of the shipping study mandated under the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990?

Captain DONOHOE. It is in final review now, Mr. Chairman, and I would expect it will be coming up with some degree of dispatch. I would hate to give you a date. As soon as I give you a date, we will probably screw it up and it will be late.

Mr. MANTON. Soon.

Captain DONOHOE. It is on the front burner. It is something I am involved in personally, and we are hopeful we will have it finished soon. As soon as it is approved by the Administration, it will be on its way.

Mr. MANTON. Thank you.

Mr. Shupp, perhaps you can give us a New York perspective, New York is obviously one of the Great Lakes States and we have been dealing with this problem for some time now. Can we go it alone there?

Mr. SHUPP. Certainly not. There is no way to go it alone. By going it alone, do you mean control or prevention?

Mr. MANTON. Both.

Mr. SHUPP. Neither.

Mr. MANTON. Neither?

Mr. SHUPP. Neither. The system is too vast to go it alone and there is no technology for most of the control now. And as far as prevention, we see the Coast Guard as the way to go with that.

Mr. MANTON. Which critter is the most damaging? I know in your testimony you made reference to several.

Mr. SHUPP. That is pretty speculative, which is most damaging. This decade or two decades down the road may be hard to predict.

If the zebra mussel productivity shifts are as dire as they may become, that certainly could be the most devastating for Lake Erie, for example. Also, again, if ruffe invades Lake Erie, the shift in species composition that that causes could be very significant. So it is a very difficult call.

If one takes place a decade before the other, the second one may not have an impact, so it is a hard one to say, Mr. Manton.

Mr. MANTON. For anybody on the panel. At this point in time are there any ballast water treatment technologies readily available to vessel operators?

Mr. CARLTON. I can say a few words about that, Mr. Chairman.

The nationally-internationally accepted technology is water exchange, which is to try to get rid of one's original water out in the mid ocean and high seas and then ballast up water from that site. By putting that water into the coastal zone, one has attempted to get rid of most of the original life.

That has been the operational choice because it falls within the ability of most ships to do that anyway when it is safe to do so. Beyond that, every individual ship may have some capabilities to do something slightly different. Some ships may have the ability to heat the water, for example, which would be rather rare.

Most of the remaining technologies are those that we have studied on paper but which have not yet been demonstrated. So that if we were to attempt to install a water filtration plant inside a ship, since there is no room inside a ship to do that, that is daunting as a first step.

To try ultrasonics, ultraviolet, any number of types of treatments require ship retrofitting, perhaps computer modeling studies, redesign, at the basic level, when the ship is built.

So, about a half dozen, perhaps as many as a dozen management technologies have been identified beyond ballast exchange. These now require field testing and, actually, getting some ships and going ahead and trying out some of these things.

Mr. MANTON. It would seem the cheapest technology would be discharge on high seas but how dangerous is that? What about the cost benefit there?

Mr. RYAN. Mr. Chairman, Great Lakes vessels have many similarities to ocean vessels, so I will respond to that question.

I think we have to just realize that every ship is merely a hull girder that is under stress and you have to balance the weights on that vessel to the buoyancy of the water underneath it. You start removing any ballast to a significant extent on the high seas and you will break that vessel and you will lose the crew. Simple as that.

Mr. MANTON. So it is not really an option. It is too dangerous.

Mr. RYAN. Perhaps on new vessels, if the strength characteristics of the vessel, with smaller tanks and with perhaps permanent ballast, but that only comes at a severe economic loss. The more permanent ballast you carry, the more steel you carry, the less cargo that is carried and that affects the commerce of the United States.

Captain DONOHOE. If I might, Mr. Chairman, jump in and add onto Mr. Ryan's.

Mr. MANTON. Surely.

Captain DONOHOE. I think if you exchange the ballast at a high rate, without any sensitivity to the impact, the disaster he mentioned is a high probability.

We currently have a fair number of vessels that do comply and they do it in a prudent way at the right time and at the right rate. We are seeing between 80 and 95 percent compliance on the ships inbound for the Great Lakes.

I think the thing that is important to mention, and goes along with what Mr. Ryan has indicated, is we leave the ultimate decision on whether or not to exchange ballast on the high seas to the master and basically indicate in the regulations and in the international guidelines that the master should not in any way, shape, or form endanger the vessel as a result of trying to exchange ballast.

Mr. MANTON. Thank you. I yield back to the Chairman.

Mr. LIPINSKI. Thank you. Mr. Coble?

Mr. COBLE. Thank you, Mr. Chairman.

Gentlemen, thank you all for being here. You know, in this era everybody says, well, let the Federal Government pick up the tab, and oftentimes we on this end may seek alternative sources. So with that in mind, Mr. Ryan, let me put a question to you.

I am pleased to hear about your association's voluntary effort regarding the ballast water management plan to control the spread of the European River Ruffe, for example, in the Great Lakes.

Do you think it would be possible—well, strike that. I guess technically anything would be possible. Do you think it would be feasible for new demonstration projects on ballast water control to be funded privately?

Mr. RYAN. No, I do not think so. We are really at the threshold of information on this subject. It is a worldwide problem. Only a few nations are tackling it. Certainly Australia, New Zealand, Canada, and the U.S. are leaders in this.

I think the domestic industry and the international trade industry would not be able to take this on piecemeal, test one piece of technology at a time. I think this is definitely a case where the gov-

ernments of the world, not just the Government of the United States, should very much engage in the kind of research that is needed to find the kind of technology.

After all, 95 percent of all the commerce of the United States is carried on foreign ships. Any efforts to be done by any U.S. shipowner, for instance, is only a drop in the bucket. It will have to be a worldwide effort, sir.

Mr. COBLE. You mentioned individual countries. Canada New Zealand, United States. What was the fourth country you named?

Mr. RYAN. Australia.

Mr. COBLE. Those are the four leaders?

Mr. RYAN. I think the Captain may know much more. He is working on those committee, but those are the four I identify.

Mr. COBLE. Captain, can you extend that list?

Captain DONOHOE. The other major player would be Japan.

There is not a lot of international involvement. These are the leaders in the IMO work group and are the nations that are in fact trying to define the scope of the problem and get the international attention needed to provide a fix.

Mr. COBLE. These are the five stars. Conversely, would there be any countries whom we would classify as the villains; or all the rest of them just are pretty much ignoring it?

Captain DONOHOE. I don't know that anybody is ignoring it, sir. What is happening is these five nations have had nonindigenous outbreaks, to use Dr. Carlton's term, and, as a result, they are a lot more sensitive to the problems associated with not properly handling or managing ballast water.

I think what we are seeing, having been involved in the last three MEPC meetings at IMO, is an increasing number of nations are becoming aware of the potential that the lack of a program brings to their national waters. And I think that through the efforts in our working group over the next meeting or two, we will see a dramatic increase in the number of nations that are sensitive to the issue and, hopefully, an increase in the number of nations that are willing to take it on as an issue to try to solve it more from a preventive standpoint than a reactive standpoint.

Mr. COBLE. Captain, based on what has been submitted thus far, I think I know what your answer will be, but I would like it for the record.

I know you and the Coast Guard have recently mandated ballast water exchange requirements in the Great Lakes in its effort to implement the Aquatic Nuisance Prevention and Control Act of 1990, I think. The Coast Guard, I am advised, furthermore, has begun to test the ballast water of oceangoing vessels as they enter the lakes' system.

Now, with these new efforts on line, do you feel that additional ballast control programs are, in fact, necessary?

Captain DONOHOE. Yes, sir, I think we need to take a look at other alternatives. As I mentioned in my formal statement for the record, and in my brief verbal remarks, there are other technologies that need to be explored.

Ballast water management and ballast water exchange as the principal alternative at this point in time provide a good line of

first defense, but I think we probably need to explore other alternatives that may, in fact, result in a more definitive outcome.

Mr. COBLE. Dr. Carlton, you mentioned the desirability of heating the water or chemically treating it. Of course, the first thought that comes to my mind is the cost thereof. Do you think the cost would be prohibitive? Or let me hear from you on that.

Mr. CARLTON. There have not been good economic analyses yet on any of these management options, not even for ballast exchange do we have any thorough numbers because of the variety of ships involved.

One thing we are facing with the application of thermal treatment or other kinds of treatment of the water could be that there are a vast variety of ships out there—container ships, passenger ships, tankers, bulk cargo carriers, general cargo carriers—and this means that the costs of management are almost sort of species-specific in many ways for the many kinds of ships.

Some of these technologies will involve recurrent costs and others could be more or less one-time retrofits. So it is hard to actually put any specific numbers on them. Many of these will be relatively costly to get up and gear up to the right level.

One of the kinds of things that we see for the long haul here would be that in new ship design we would build into vessels some of the best possible technologies, which means that these costs would be part of the entire ship operation, as with any other part of a normal ship operation.

Mr. COBLE. Thank you, lady and gentlemen, for being with us. Thank you, Mr. Chairman.

Mr. LIPINSKI. Thank you, Mr. Coble.

I thought maybe we could fund this entire operation by taxing the ballast water discharge. Would so much per gallon be the way to handle that?

Mr. COBLE. We might want to consider that.

Mr. LIPINSKI. I thought you might want to consider that.

Mr. Taylor?

Mr. TAYLOR. Thank you, Mr. Chairman.

In listening to this, I am kind of struck by the analogy of closing the barn door after the horse has already gotten out. After all, the zebra mussel is here, the lamprey eel is here. This has been going on, as your report states, at least since World War II.

I have two questions. Why the sudden emergence, if this has indeed been going on since World War II, if not before, why the sudden emergence of the lamprey eel? Why the sudden emergence of the zebra mussel? As opposed to why didn't they show up in the 1950's; why didn't they show up in the 1960's; or why didn't they show up in the 1970's?

Second thing is when you talk about 25 million gallons of water to treat, that is not really a great deal of water. I would think a sewage treatment plant in any midsize city puts out 25 million gallons of water a day and it is chlorinated at the last stage before it is released into the streams or navigable waters of this country. From what I understand, the things you really need to get out of the water, choli and some other things, are killed with that, and I was wondering, I didn't even see that listed as a possible solution.

Of course, the third alternative—I am sure the steamship companies would go absolutely bonkers over this—but if any thought was given to a possible quarantine station-type site at a port of entry, be it below the city of New Orleans on the Mississippi River, be it at some point near San Francisco Bay, where when you are entering an area with a designated ballast spot that has either a high enough river flow, high enough salinity and yet it is still a safe place, getting back to what this gentleman was talking about, since it is going to involve some time and, obviously, you want to do it in a place where the vessel would not be subjected to very high seas, very high winds.

I am curious if anyone would like to comment on that.

Dr. CARLTON. I will start with your first question about why now? Why do invasions continue? It is one of the more vexing questions and one of the problems in making predictions about what the next invading species will be.

Why the mussel did not invade North America before the 1980's, we just do not know. There are a number of possibilities. Ballast water from Europe, from zebra mussel source areas, was being brought over here for many decades and yet the zebra mussel failed to appear. That has led to speculation about other sorts of species that if they were going to be here, they would be here by now. And, clearly, the zebra mussel shows us that that is simply something we cannot say.

In May of 1988, we might have rounded up a number of biologists in this country who would have said that about the zebra mussel. "If it was going to be here, it would be here by now." And of course in June of 1988 it was discovered.

But things change along these corridors, these conveyor belts. It may be that the source area changed. It might be that zebra mussels became more abundant in some European harbors because the European harbors were becoming cleaner and more conducive to large populations of zebra mussels and they were ballasted up. That is a donor area hypothesis.

Another hypothesis is that the receiver area changes. The Great Lakes were not the same in the 1950's, and they changed in the 1960's, and they changed in the 1970's, and by the 1980's the Great Lakes became a different kind of environment, in part perhaps because of environmental amelioration. We made a tremendous attempt to clean up the Great Lakes and this is a more hospitable environment for more species.

A third hypothesis would be that the vector is changing. There is more ballast water. The ships are faster. The survival getting across the oceans is greater and, therefore, more things are surviving.

A fourth hypothesis would be that it was a massive inoculation event. It simply was a stochastic sort of thing; that one ship came over with hundreds of millions of zebra mussel larvae and dropped those on just the right day in Lake St. Clair and it was a sort of a stochastic inoculation.

A fifth hypothesis is called the invasion window hypothesis, and that is that everything has to be right on a certain time for a species to be established, and all the variables rarely come together at

the right moment. So this makes it difficult to predict what the next one is.

As far as the barn door being closed too late, there are many species out there in Europe, Asia, South America, that have yet to gain access to North America and that can be carried to North America and to the United States by ballast water, and we would certainly not want them here.

Mr. RYAN. If I could comment on that, Mr. Taylor.

It would be catastrophic for the shipping industry of the world if there were quarantine stations of the magnitude that would be needed. I think Dr. Carlton would be better qualified to state how long it would take to test the biological and species level of life in a tank. We are talking about tanks several times the size of this room in many cases. We are talking about a lot of water.

The Great Lakes trade, we, in fact, are changing ballast every few days. We take cargo on one day and discharge it, and the next day we are in ballast and the next day we are loading. So we are constantly taking on and discharging ballast.

In the international trade, although the ballast water may be on board longer, you are dealing with larger vessels. And what should be very clear is although the ballast water exchange program for the lakes works, it is because the maximum size vessel is 26,000 tons. Heck, the large vessels coming into the United States are much larger than that. The Saint Lawrence River itself is a problem because they have ships of 150,000 tons, and those ships cannot exchange ballast the same way smaller boats can. And so you have the magnitude of size.

Regarding the chlorine level, this is part of the problem with using any chemicals. And, let's face it, in the lakes there is a current controversy as to how much chlorine should go into the system. In fact, there are some folks who would like to see Lake Superior chlorine-free. There is a major debate on that.

But if we had enough chlorine to kill the fish in the tanks, I wonder what port would receive our ballast water as we discharge it into their water where their desirable fish are living; whether we would have a great fish kill. So there are certain problems, sir.

Mr. TAYLOR. If I am not mistaken, almost every city in America chlorinates its water, its wastewater, as it goes out to wherever it is going. If I am not mistaken, every city is mandated to do that. And chlorine, one of the good things about chlorine, is that the sunlight will break it down within a short period of time once it is introduced into the water.

Believe me, I am not a great advocate of putting additional costs on the steamship industry, and I am not so sure that we can change anything now if we try. There is always the case, as Dr. Carlton says, of one guy who happens to catch one species spawning or in spat, or whatever you want to call it, and got into a temperature who, one night as he arrives in some port decides he is going to dump his tanks. This may all be quite an effort in futility.

Ms. KIMBALL. If I might, I think one of the differences is, in sewage treatment plants the chlorine is used to eliminate bacteria. In these cases, we may be using chlorine to eliminate fish, and we would have concerns about the impact on different aquatic species that we do want to survive in the water.

Captain DONOHOE. If I might add, too, Mr. Chairman, I think as part of the response, there are a lot of different barns out there with a lot of different doors. And I think one of the things we are looking at and one of the component parts of the draft legislation is to do a study, to take a look at other alternatives. Chlorine may be a chemical that will work, but there may be others that will work better and do not pose a threat to the environment.

We believe there are alternative opportunities to treat ballast water and if we can take a look at whether it is a chemical treatment, a thermal treatment, sound treatment, light treatment, whatever, and do some cost analysis, we will be in a markedly better position to select those that might be viable for demonstration projects.

And I think the other point Mr. Ryan made was there is an awful lot of boats coming into the U.S. that don't carry the U.S. flag, and this is going to be a significant shift in operations; that we will have to take a look at how we are going to solve the problem once we identify the technologies.

Mr. SHUPP. Another comment, Mr. Chairman, on the barn door concept.

There are two fish diseases, one bacterial, one viral, that are not now present on this continent to any degree. If brought into a coastal environment, or a Great Lakes environment, on a fish; brought in through ballast exchange; those two diseases could literally devastate the native salmon and trout populations in the Great Lakes.

The private and public fish hatcheries in this country, as we know them today could be out of business, until we fought our way back, recovered and regained ability to manage around those diseases. This is one of the biggest fears we in the fishery management business have with this ballast exchange issue. And that barn door, if ever opened, would devastate our fisheries very quickly, very quickly, and have a multibillion dollar impact.

So we have lots of doors we do not want to open and that is certainly one of them that would be the most acute and could happen at any given time.

Dr. CARLTON. If I could address again this issue of the futility of this. I would hate for anybody to leave this hearing thinking that it was too late or that the problem is so massive and complex with these thousands of vessels from many different nations, ships from one to 30 years old are coming in and so forth, that it was too much to really handle.

What we are talking about is quarantine science, and what we are trying to throw out here is a blanket across wholesale release of ballast water with no control. In many ways, any quarantine system that we would effect will have holes in it, and so there is no implication here that this is going to be a solid wall and after we build that wall no invasions will come in by ballast water.

We have in place in this country, through the U.S. Department of Agriculture and its quarantine systems, one of the most sophisticated means to intercept exotic insects coming into this country. And after many decades of this work, and with hundreds of inspection stations and really superb work, invasions continue. But we do not think that it is not working. We celebrate what is not here.

And so it is extremely important to look at ballast now, for the next decade and the next decades to come, as something we can by implementation of a few more technologies and international cooperation severely depress this mechanism and reduce the rate of invasions which are now rather staggering.

Mr. LIPINSKI. Thank you. Mr. Kingston?

Mr. KINGSTON. Thank you, Mr. Chairman.

Captain Donohoe, you had mentioned—actually, Mr. Manton and Mr. Coble asked two questions I want to tie in. Mr. Manton asked what was the worst creature and Mr. Coble said who is not complying.

Have you thought about trying to target the top 10 worst creatures and find out what the correlation is between compliance in those countries and where those species are indigenous?

Captain DONOHOE. No, sir, we have not. I am not sure we are in a position—Dr. Carlton may be able to give you a list of the top 10, or the 10 most wanted creatures.

Mr. KINGSTON. It would just make sense to target, even though you cannot get everybody, at least start strong-arming those countries for voluntary compliance.

Dr. CARLTON. Do you mean the top 10 species not yet here?

Mr. KINGSTON. Either way. Because I assume the zebra mussel is still coming in; right?

Dr. CARLTON. We hope not, not into the Great Lakes. If zebra mussel is coming in, it could come in in freshwater ballast coming into other freshwater ports, but hopefully not into the Great Lakes.

Mr. KINGSTON. Well, would it make sense to figure out which were the most damaging species and find out where they are indigenous and then try to work on those countries for voluntary compliance?

Dr. CARLTON. It would be of great interest to have a global hot spots checklist and know where there were major pulses right now of invasions occurring; where there were major population increases of exotic species that we do not desire in this country; we would rather not have water from those places.

A good example right now is there is a small crustacean (shrimp-like organism) which has become extremely abundant in the Rhine River through the Netherlands and Germany, and it is likely if we are getting Rhine River water, we could get that little organism.

Mr. KINGSTON. Well, if, as Mr. Taylor was saying, you could filter out these species on the ships from the countries with the worst species that we need to target, the more critical areas, is it possible, is there technology, and, Captain Donohoe, you might know, if there is some sort of filter that could be used.

And I know that would be more expensive, but if you do not require it universally but just in the crucial areas, would that be a step in the right direction?

Dr. CARLTON. It is the kind of thing we are talking about in this proposed legislation where it would be one of the demonstration options.

Could we, in fact, attempt to install some kind of a filtration system on a test vessel and see how it would work? Can we transfer some of this filtration technology which exists in water filtration plants into the ship? In a ship's engine room or ship's ballast-

ing system there is hardly room to put a bread box, so one would have to do some redesign, some retrofitting, get our good friends in the shipping industry to donate a ship to us.

Captain DONOHOE. Let me just add, too, Mr. Kingston, one of the issues that is important to mention is that the way cargoes move around the world it is difficult to identify a particular vessel that may be in one port today and get rerouted to another. So we need to make sure we have some kind of systemic approach that treats the transporter as opposed to the critter itself or the nation from which it comes.

To the extent we increase awareness through education that this possibility exists by educating the mariner and also trying to identify technologies that might be made available to the shipping community, it probably is a little better fix than trying to look into the crystal ball and figure out which critter will make the top 10 list and which nation that has those bad critters.

Mr. KINGSTON. Let me ask another question on a different subject. I know certain freshwater fish can live in salt water. For example, tropical fish, black molly, can live in a salt water or freshwater aquarium, and I understand there are certain kind of bass that can live—there are salt water bass that can live in freshwater. I don't know if that is correct or not, but I understand that.

Have we, and I know your study concentrated on the Great Lakes, but have we looked at what this is doing to ships going up and down intercoastal waterways, following up the streams and tributaries to the brackish water and then to the freshwater? Has there been intrusion into freshwater and brackish water?

Dr. CARLTON. Do you mean are we transporting species along the coastlines?

Mr. KINGSTON. Along the intercoastal waterways.

Dr. CARLTON. Between ports and so on?

Mr. KINGSTON. I am thinking more in terms of sailboats and recreational. And I know it is not ballast, but they get under the keel of a sailboat and then they can fall off and attach on.

Dr. CARLTON. We assume a good deal of that sort of transport is going on, but there are really not any studies on that.

Mr. KINGSTON. Thank you, Mr. Chairman.

Mr. LIPINSKI. Thank you, Mr. Kingston.

Ms. Kimball, will the consultation and cooperation provisions in the Ballast Water Control Act impede or enhance the Secretary's efforts to meet the act's goals?

Ms. KIMBALL. We believe that it enhances the Secretary's ability to meet the goals. One of the things that we think is important in the Act is it brings together all the Federal agencies so we can develop a coordinated Federal policy.

I know the OTA report was somewhat critical of that, but we think that it is a necessary step that will help us speak with one Federal voice to coordinate our efforts and our resources to address this serious problem.

Mr. LIPINSKI. Thank you.

Dr. Carlton, would any one ballast water management technology or practice eliminate the threat of aquatic nuisance invasions?

Dr. CARLTON. No. What we are seeing developing very clearly, with every passing year of our increased understanding of the role

of ballast in moving organisms around the world, are that we are going to be selecting from a broad menu of options, and some of those options are start-at-home options, where if you look over the side of the ship and the water is red, and there is a red tide, then we ask the mariner not to ballast up the red tide into his ship to carry it to another port. That is ballasting micromanagement.

In the same sense, there might be filters aboard the ship of the future. The ship might exchange its water anyway on the high seas. The ship might choose not to deballast in a sensitive zone at the target area.

So what we want to start thinking here is that it is really a whole broad menu of control options from the beginning of the trip, through the trip, to the end of the trip, and that some of these things are applicable immediately and others are the kinds of technologies that we are going to have to develop in the future.

I have a hard time seeing, as with any quarantine system, that any one option is really going to be the answer.

Mr. LIPINSKI. Thank you.

Mr. Kingston asked you a question about going from a seaport into inland waterway system, and I was distracted. I heard the question but I did not hear your answer. Is that occurring, where we have an oceangoing vessel getting rid of their ballast waters, say—well, any port, and then those species wind up in inland water systems. Do you we have any evidence of that occurring?

Dr. CARLTON. It certainly can occur. That is really the story of the Great Lakes, in many ways, but now that could occur in the Hudson River, in the upper portion of the Chesapeake Bay, in the Mississippi River and the San Francisco Bay delta region, in the Columbia River and so on, where a ship coming in with salt water ballast could release that salt water into a freshwater environment.

In large part, most of those organisms would die because they are salt water organisms released into a freshwater environment. There are organisms that can survive that kind of change in salt content, that kind of change in salinity, and that is also the source of some of the salt water invasions historically in the Great Lakes, we believe.

With the Great Lakes' laws on the books, with the Hudson River laws about to happen, we simply leave the other ports at the moment still open for that kind of water release.

Mr. LIPINSKI. Thank you.

Mr. Ryan, I applaud the Lake Carriers' voluntary efforts to curb the spread of the river ruffe, however, does ballast water exchange in deep and in cold water entirely eliminate the possibility if a ruffe transfers through ballast water?

Mr. RYAN. When we developed the criteria for exchange, we did so with the help of the U.S. Fish and Wildlife Service. It was their advice that the water exchange, which might have ruffe in it, be done a certain distance offshore and in certain depths of water. Unfortunately, at a recent meeting I attended, they have discovered that the ruffe have been captured at deeper and colder—in deeper and in colder water than previously was thought. Don't know the import of that.

We have a second demarcation line in the Great Lakes that allows a vessel master, if he cannot exchange by a certain point, to move to another area, and in that second area we say you can only discharge in water of 240 feet deep. No ruffe have been, at least to my knowledge, caught in that depth of water.

Mr. LIPINSKI. Dr. Carlton, do you have anything to add to that, by any chance?

Dr. CARLTON. No, we are just going to have to watch that and see how that all goes.

Mr. LIPINSKI. Thank you.

Captain Donohoe, could the proposed Marine Board's study be used to fulfill the study that the Ballast Water Control Act would require?

Captain DONOHOE. Yes, sir. The Marine Board study that we proposed, and we are talking to the Marine Board about conducting, was exactly on the lines of identifying and helping us describe alternatives. So if that study is pursued, we are confident that it would, in fact, deliver to the Congress the report that you have described in your legislation.

Mr. LIPINSKI. Thank you.

Mr. Lasky, does the Ballast Water Control Act allow sufficient flexibility for the Secretary of Transportation to maximize agency and private sector expertise?

Mr. LASKY. We believe it does.

Mr. LIPINSKI. You believe it does?

Mr. LASKY. Yes.

Mr. LIPINSKI. Mr. Taylor, do you have any more questions?

Mr. TAYLOR. No, sir.

Mr. LIPINSKI. I have no more questions at this particular time. I sincerely appreciate all of your being here, once again. Thank you for your testimony.

As I say, it was very interesting, very informative, and it certainly is going to be enormously helpful to us as we pursue this issue. Thank you.

[Whereupon, at 11:20 a.m., the Subcommittees were adjourned; and the following was submitted for the record:]

I

103D CONGRESS
1ST SESSION

H. R. 3360

To direct the Secretary of Transportation to demonstrate on vessels ballast water management technologies and practices, including vessel modification and design, that will prevent aquatic nonindigenous specifies from being introduced and spread in United States waters.

IN THE HOUSE OF REPRESENTATIVES

OCTOBER 26, 1993

Mr. LIPINSKI (for himself, Mr. TAUZIN, Mr. MANTON, Mr. STUPAK, and Mr. LAFALCE) introduced the following bill; which was referred to the Committee on Merchant Marine and Fisheries

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A BILL

To direct the Secretary of Transportation to demonstrate on vessels ballast water management technologies and practices, including vessel modification and design, that will prevent aquatic nonindigenous specifies from being introduced and spread in United States waters.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the "Ballast Water Control Act".

SEC. 2. DEFINITIONS.

In this Act—

(1) "Secretary" means the Secretary of Transportation;

(2) "ballast water" means water and sediments taken into or expelled out of a vessel's ballast system;

(3) "Aquatic Nuisance Species Task Force" means the task force established in section 1201 of the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (16 U.S.C. 4721); and

(4) "nonindigenous species" has the meaning given the term in section 1003(9) of the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (16 U.S.C. 4702(9)).

SEC. 3. BALLAST WATER MANAGEMENT STUDY.

(a) IN GENERAL.—The Secretary shall study ballast water technologies and practices that prevent aquatic nonindigenous species from being introduced and spread through ballast water in the Great Lakes and other United States waters.

(b) IDENTIFICATION OF TECHNOLOGIES AND PRACTICES FOR DEMONSTRATION.—Based on the study under subsection (a), the Secretary shall identify for demonstration under section 4 technologies and practices that—

(1) may be retrofitted on existing vessels or incorporated in new vessel designs;

(2) are operationally practical;

(3) are safe for vessel and crew;

(4) are environmentally sound;

(5) are cost effective; and

(6) the vessel operator can monitor.

SEC. 4. BALLAST WATER MANAGEMENT DEMONSTRATION PROGRAM.

(a) IN GENERAL.—The Secretary shall conduct an 18-month ballast water management demonstration program to demonstrate technologies and practices, including those the Secretary identifies under section 3, to prevent aquatic nonindigenous species from being introduced and spread through ballast water in the Great Lakes and other United States waters.

(b) UNITED STATES SHIPYARDS AND SHIP REPAIR FACILITIES.—Installation and Construction requiring a shipyard or ship repair facility shall be performed in a United States shipyard or ship repair facility.

(c) VESSEL SELECTION.—In demonstrating technologies and practices on vessels under this section, the Secretary shall—

(1) use only vessels that—

(A) have ballast systems that test the technologies or practices;

(B) are documented under the laws of the United States; and

(C) are actively used for trade or other maritime or public purposes during that demonstration; and

(2) seek to use—

(A) vessels that call on ports in the United States on the Great Lakes and vessels that are operated along the other major coasts of the United States and inland waterways; and

(B) a variety of vessel types.

SEC. 5. AUTHORITIES; CONSULTATION AND COOPERATION WITH INTERNATIONAL MARITIME ORGANIZATION AND AQUATIC NUISANCE SPECIES TASK FORCE.

(a) AUTHORITIES.—In conducting the study under section 3 and the demonstration program under section 4, the Secretary may—

(1) enter into cooperative agreements with other government agencies and private entities;

(2) accept funds, facilities, equipment, or personnel from other Federal agencies; and

(3) accept donations for property and services.

(b) CONSULTATION AND COOPERATION.—The Secretary shall consult and cooperate with the International

Maritime Organization and the Aquatic Nuisance Species Task Force in carrying out this Act.

SEC. 6. REPORTS TO CONGRESS.

The Secretary shall submit a report to the Congress—

(1) no later than 18 months after the date this Act is enacted on the results of the study conducted under section 3, that specifies the technologies and practices for demonstration under section 4; and

(2) no later than three years after the date this Act is enacted on the findings for and recommendations resulting from the demonstration program conducted under section 4.

SEC. 7. AUTHORIZATION OF APPROPRIATIONS.

There is authorized to be appropriated to the Secretary $2,000,000 to carry out this Act.

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TESTIMONY OF
KATHARINE W. KIMBALL
DEPUTY ASSISTANT SECRETARY FOR OCEANS AND ATMOSPHERE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

BEFORE THE

SUBCOMMITTEE ON FISHERIES MANAGEMENT
SUBCOMMITTEE ON MERCHANT MARINE
SUBCOMMITTEE ON COAST GUARD AND NAVIGATION
MERCHANT MARINE AND FISHERIES COMMITTEE
U.S. HOUSE OF REPRESENTATIVES

OCTOBER 27, 1993

Mr. Chairmen and Members of the Subcommittees:

I am Kate Kimball, Deputy Assistant Secretary for Oceans and Atmosphere, National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Commerce. I appreciate this opportunity to present the goals and accomplishments of the Aquatic Nuisance Species Task Force (Task Force) and NOAA's efforts as co-chair to prevent the introduction and spread of aquatic nuisances in U.S. waters.

Aquatic nuisance species have the potential to threaten every industry that uses water and therefore indirectly affect every U.S. citizen. In response to the infestation of the world's largest freshwater reservoir by zebra mussels, the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (Act) was passed. The Act was designed to mitigate the overall problem of aquatic nuisance species and to achieve this end established an interagency Task Force. The Task Force is co-chaired by NOAA and the U.S. Fish and Wildlife Service (FWS) and is composed of

representatives from the Coast Guard, the Environmental Protection Agency (EPA), the Department of the Army (Corps of Engineers), the Department of Agriculture, and the Department of State. The primary goal is to prevent the unintentional introduction and spread of exotic species in U.S. waters and to mitigate the impacts of those species that become established.

The Act assigns a weighty responsibility to the Task Force and NOAA is honored to have been named a co-chair. The Task Force has moved forward to fulfil the mandates of the Act in an approach that has proven to be not only fiscally responsible, but creative as well. We are proud of our achievements to date. I will begin by describing the Task Force's efforts related to ballast water.

As part of the National Ballast Water Control Program, the Task Force is mandated to conduct Ballast Exchange and Biological Studies. The Ballast Exchange Study is scheduled to begin in the Spring of 1994 to assess the environmental effects of ballast water exchange on the diversity and abundance of native species in U.S. waters and to identify areas, if any, where exchange does not pose a threat. The project is being initiated with funds from EPA's Office of Research and Development and will be conducted at and administered through NOAA's Great Lakes Environmental Research Laboratory (GLERL). Additional funds from NOAA and the FWS should allow completion of the study no later

than June 1995. The study will include the environmental impacts of the release of salt water in the Great Lakes and other U.S. freshwater ports, the survival potential of open ocean organisms in coastal zones, and the identification of backup exchange zones, if such exist.

The Biological Study currently is being conducted to determine whether ANS threaten the ecological characteristics and economic uses of U.S. waters other than the Great Lakes. The study was initiated with FWS funds and currently is proceeding on a case study basis. Additional funds from NOAA and the EPA will be used to complete the case studies. A study on the environmental impacts of aquatic invasions in the State of Florida, begun in July 1993 by the FWS, will be completed in the Spring of 1994. A similar study on the fresh, brackish, and marine waters of the San Francisco-Delta region began in September 1993 and will be completed by September 1994. A case study of the Chesapeake Bay may begin later this fiscal year.

The Shipping Study, which also is part of the National Ballast Water Control Program, is under the purview of the Secretary of Transportation and will not be addressed in this testimony.

Section 1102(d) of the National Ballast Water Control Program and section 1206 of the Act encourage the Task Force representatives to enter into negotiations and cooperative efforts with foreign

countries regarding prevention and control of ANS and management, research, control, and education efforts. In July of this year, the International Maritime Organization's (IMO) Marine Environmental Protection Committee (MEPC) discussed the issue of harmful marine organisms in ballast water. At the Coast Guard's request, NOAA submitted a paper on the Task Force's activities and was represented on the U.S. delegation. MEPC has subsequently recommended a formal working group be convened on the issue to consider further developing IMO's voluntary ballast water guidelines as the basis for an annex to the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78). The Task Force will continue to work with IMO on this important issue. MEPC also recommended exploring the possibility of convening an international ballast water symposium. Because NOAA sponsored an international workshop on Nonindigenous Estuarine and Marine Organisms (NEMO) in April 1993, during which the issue of ballast water was raised, the Coast Guard has approached NOAA regarding sponsorship of the ballast water symposium. NOAA would like to sponsor the workshop in conjunction with the Task Force. We have recently approached the Government of Australia, which has been involved in this field for many years, regarding dual sponsorship of such a workshop. The Australians currently are considering the proposal.

The NEMO workshop was sponsored by NOAA to assist the Task Force's efforts, and the efforts of foreign countries, in

determining appropriate management and research activities for estuarine and marine areas. Five countries were represented at the workshop which proved to be an excellent forum for assessing our current understanding of the effects exotic species are having globally. The results of the NEMO workshop and an update on Task Force activities are being presented at the 2nd International Conference on the Environmental Management of Enclosed Coastal Seas being held in Baltimore, Maryland in November 1993.

An additional international effort in which the Task Force has been involved includes participation in the 1992 United Nations Conference on Environment and Development (UNCED). A representative from NOAA's Office of the Chief Scientist was a member of the U.S. delegation to the UNCED and strongly supported the U.S. proposal to the UNCED Secretariat which included language urging the international community to adopt appropriate safeguards for ballast water discharge and to adopt the Food and Agriculture Organization/International Council for the Exploration of the Sea guidelines for the transfer and introduction of marine and freshwater organisms.

The central component of the Act is development of a nationwide Aquatic Nuisance Species (ANS) Program to prevent the unintentional introduction and spread of ANS and to monitor, control, and study aquatic nuisance species. The Task Force

began development of the ANS Program in February 1991. Because the issues involved in its development have been more extensive and complex than originally anticipated, its development has taken longer than the 12 month timeframe outlined in the Act. The development, clearance, and public review process recently has been completed, however, and the final ANS Program is expected to be approved by the Task Force at its November 1993 meeting. Pending Departmental and OMB approval, it will be forwarded to Congress. The ANS Program builds upon existing nonindigenous species activities and will be a cooperative effort among Federal and state agencies, local government, and nongovernmental entities. To achieve the Task Force's goals, the ANS Program consists of the following elements: prevention, monitoring and detection, control, research, technical assistance, education, and a Zebra Mussel Demonstration Program.

Prevention of unintentional introductions of nonindigenous aquatic species will be undertaken through a pathway identification, risk assessment and mitigation process which will be developed by the Task Force's Risk Identification and Management Committee. The committee will be modifying a process developed by the Department of Agriculture's Animal and Plant Health Inspection Service for evaluating nonindigenous plant pests to develop the risk assessment portion of this element.

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Detection and monitoring of ANS will be accomplished through coordination of existing activities and field studies by the Monitoring Committee, and through a data repository and information management system currently in operation at the Fish and Wildlife Services's National Fisheries Research Center in Gainesville, Florida. NOAA has been involved in this area since the early 1960s when the National Marine Fisheries Service (NMFS) established an aquatic shellfish disease research program. In addition to shellfish pathogen research, NMFS monitors the presence of pathogens in imported seafood through a Memorandum of Understanding with the Food and Drug Administration. In addition, NOAA's National Estuarine and Research Reserve System (NERRS) has existing monitoring programs for base-line parameters. The sites are well integrated with state agencies and the academic communities around them. They can be used as a framework from which to initiate a long-term monitoring program for the occurrence and spread of exotic species. Additional monitoring responsibilities also can be incorporated into NOAA's National Status and Trends Program which assesses the effects of human activities on environmental quality in the nation's coastal zones through benthic sampling and bioeffects research.

Control of ANS will be addressed through a control risk assessment and management process outlined in the ANS Program. The Task Force currently is using this process in regards to the unintentional introduction of ruffe, a European perch, via

ballast water into Lake Superior. The Task Force determined that control is warranted for ruffe and convened a Ruffe Control Committee to assist with the development and review of a control program. A proposed program has been developed and upon completion of the environmental assessment document it will be released by the Task Force for public review. Proposed control measures include ballast water management through voluntary guidelines, range reduction through the use of piscicides, education, predator evaluation, and surveillance and population investigations.

Research is the fourth element of the ANS Program. To ensure that research activities carried out under the Act do not result in the introduction and spread of ANS in U.S. waters, the Task Force was directed to develop a research protocol. A Protocol for Evaluating Research Proposals Concerning Nonindigenous Aquatic Species was developed by the Task Force and released as an interim working protocol in September 1992. The final protocol is expected to be issued in November 1993. To assist the Task Force's Research Protocol Committee in evaluating proposals specific to zebra mussels, NOAA and the EPA funded a workshop at GLERL that resulted in the development of Zebra Mussel Containment Protocols. These protocols currently are used in conjunction with the research protocol mentioned above to ensure zebra mussels are not spread through research.

ANS research grants are being administered through NOAA's National Sea Grant College Program. The Sea Grant Zebra Mussel Program focusses on the effects of zebra mussels on infrastructure and the environment and the development and evaluation of potential control methods. GLERL's Nonindigenous Species Coordinated Research Program also is playing an integral role. Researchers have been monitoring Saginaw Bay in Lake Huron, prior to and following its infestation by zebra mussels. They also are conducting a variety of life history studies. In addition, beginning in 1995, NOAA's National Estuarine and Research Reserve System, will have as a research priority the study of alterations of habitat utilization by coastal biota and restoration of coastal habitats that have been impacted by nonindigenous species. Elements of the Department of the Interior's Fish and Wildlife Service, which will soon become part of the new National Biological Survey, also are actively involved with zebra mussel research. The Task Force will be convening a Research Coordination Committee in the near future to coordinate existing research activities and identify additional needs and priorities.

Technical assistance and education are the remaining key elements in the ANS Program. Education will be part of each element of the ANS Program. The FWS and a number of state agencies already have developed a variety of effective educational programs and activities. NOAA's National Sea Grant College Program also

provides education and technical assistance through its state Sea Grant offices and Marine Advisory Service program. The Zebra Mussel Information Clearinghouse is a project of New York Sea Grant. The clearinghouse publishes the Dreissena Polymorpha Information Review which summarizes research, meetings, legislation, and sightings of the zebra mussel to encourage and facilitate communication among interested parties. The combination of Sea Grant's program has resulted in a closely integrated network of researchers and extension agents who are developing control methods and communicating the results to local communities. Proposed outlets for additional education and technical assistance activities include the FWS Fishery Assistance Offices and the Department of Agriculture's Cooperative State Extension Service.

Education will play a key role in the overall success of the ANS Program and the Task Force has recently set its sights on its own backyard for implementation of a new educational initiative. Two rivers thread their way through the heart of the nation's capital, the Potomac and Anacostia. NOAA is developing a River Watch program for the Task Force to protect these rivers from exotic species such as the zebra mussel. The Anacostia recently was named the fourth most endangered river in the U.S. The River Watch program will be a part of the regional effort to protect the local rivers and supports the goals of the President's ecosystem management initiative. The program will be a

cooperative effort between local government, conservation organizations, and recreational users to help protect and monitor the rivers and to encourage the inclusion of ANS prevention and control measures in management policy.

The ANS Program elements target zebra mussels in addition to other exotic species. Collectively these elements constitute a Zebra Mussel Demonstration Program. As part of this demonstration program, the Army Corps of Engineers is overseeing a research and technology development program for the environmentally sound control of zebra mussels in and around public facilities.

There are a number of other activities being conducted by the Task Force that are not directly a part of the ANS Program but contribute to its direction and implementation. The Task Force was directed to convene a panel of Great Lakes representatives to identify Great Lakes priorities, make recommendations to the Task Force, and assist the Task Force in coordinating efforts in the Great Lakes. A Great Lakes Panel (Panel) was officially convened in the Fall of 1991. In addition to formulating a work plan for the Great Lakes Basin, the Panel actively sponsors briefings and dialogues among elected officials and policy makers and is reviewing current management and control initiatives in the region.

The Act also outlines a State Aquatic Nuisance Species Management Plans and Grants Program whereby a state can submit management plan(s) for public facilities and other areas and activities in need of such a plan to the Task Force for its review. Upon approval of the plan(s), partial funding may be provided to the states. The State of New York submitted a draft management plan to the Task Force for preliminary review.

At the time the Act was passed, Congress recognized that there were potential problems with intentional as well as unintentional introductions. Intentional introductions are defined to include accidental releases from holding and production facilities (e.g., hatcheries, aquarium plant or fish facilities) as well as introductions directly released to aquatic ecosystems (e.g., stocking programs). Because there was insufficient information available on the options for reducing adverse consequences associated with intentional introductions to justify Congressional action, the Task Force was directed to conduct an intentional introductions policy review. The policy review has been conducted and completed public review on October 25, 1993. After Task Force review and pending Departmental and OMB approval, it will be forwarded to Congress.

The Task Force also is responsible for developing a brown tree snake control program. Although brown tree snakes are not an aquatic species, they accidentally were introduced to the island

of Guam via ship cargo from the Papua, New Guinea area. Snakes also have been sighted on Oahu, possibly having been transported in the wheel wells of aircraft. The snake has become a serious problem on Guam, causing electrical outages and adversely affecting native species. The Task Force's Brown Tree Snake Committee is working in conjunction with territorial and state agencies on development of a control program.

The waters of the United States are a resource of immeasurable economic, environmental, and aesthetic value. The ANS Task Force is determined to protect U.S. waters from the threat of exotic species. Mr. Chairmen, thank you for the opportunity to testify on this important issue. I will be pleased to answer any questions you may have.

TESTIMONY on the Need for a "Ballast Control Act"
Hearings, October 27, 1993
Dr. James T. Carlton
Maritime Studies Program
Williams College - Mystic Seaport
Mystic CT 06355

The Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (Public Law 101-646) established a "National Ballast Water Control Program" which in turn mandated "Studies on Introduction of Aquatic Nuisance Species by Vessels." One of these studies is the "Shipping Study", defined as follows:

> "a study to determine the need for controls on vessels entering waters of the United States, other than the Great Lakes, to minimize the risk of unintentional introduction and dispersal of aquatic nuisance species in those waters. The study shall include an examination of -- (A) the degree to which shipping may be a major pathway of transmission of aquatic nuisance species in those waters; (B) possible alternatives for controlling introduction of those species through shipping; and (C) the feasibility of implementing regional versus national control measures."

This study commenced in December 1991 in our laboratory at the Williams College -- Mystic Seaport Maritime Studies Program in Mystic CT. Funding was provided by the U.S. Coast Guard (USCG) through the National Sea Grant Program. The study assumed the working name of the "National Biological Invasions Shipping Study", or NABISS, to address the three study elements listed above.

We studied ballast water and port operations by direct visits and vessel boardings, with USCG cooperation, in selected major U.S. ports, and by a cooperative effort with USDA Animal and Plant Health Inspection Service (APHIS) inspectors. Ports selected for analyses were based upon vessel traffic volume derived from U.S. Census data. We determined actual ballast carried versus ballast capacity, and a wide range of other data on ballasting, deballasting, and exchanging operations. We further sought by using these and U.S. Customs/U.S. Census data to estimate the amounts and sources of ballast

water arriving in United States ports.

We assessed ballast release patterns in ten major U. S. commercial, hydrographic and biogeographic regions: (1) Gulf of Maine, (2) mid Atlantic, (3) the south Atlantic, (4) the eastern Gulf of Mexico, (5) the western Gulf of Mexico, (6) southern California, (7) northern California, (8) the Pacific Northwest, (9) Alaska, and (10) the Hawaiian Islands. To determine potential control and management options, and for data collection in general, we spoke, wrote, and worked with over 500 persons in industry and in international, national, state, and local agencies, institutions and universities.

A portion of the findings and conclusions relative to ballast water of the Shipping Study (which also examined non-ballast mechanisms such as hull fouling) is as follows:

- There are three major divisions of ocean-going vessels: Passenger vessels, including liners, ferries, and excursion boats, cargo vessels, including bulk carriers, container ships, and tankers, and specialized vessels, including barges, fishing vessels, and semisubmersible exploratory drilling platforms. A vessel may be viewed as a "biological island" with organisms occurring on the outside (as fouling organisms, or "biofouling"), on the inside (in ballast water and sediments), and aboard the vessel (insects, spiders, rodents, and many other organisms).
- Ballast water is taken aboard to stabilize a vessel at sea and for a variety of other purposes. Ballast water may be fresh (0.5 parts per thousand (o/oo) dissolved salts or less), brackish (salt levels ranging from more than 0.5 to 30 o/oo) or salt (greater than 30 o/oo). Most ballast water contains living organisms and dissolved and suspended organic and inorganic compounds. Transoceanic and interoceanic use of ballast water commenced in the 1880s, although it is probable that it was not until during and after World War II that ballast water in appreciable volumes began to be moved around the world.
- Ballast water is pumped aboard a vessel from several meters depth with

dedicated ballast pumps. The same pump and the same external hull openings are normally used to take water into (fill or ballast) and remove (discharge or deballast) water from a vessel. The ballast intake is normally covered with a steel plate (a grate or strainer) with numerous holes of 1.0 to 1.5 cm diameter. Water may also be gravitated in or out of a tank or hold.

- A vessel may have water from multiple sources, with water from different sources mixed or unmixed different tanks. In biological terms this means that a vessel may accumulate organisms from multiple ballastings. Container ships represent one of the best examples of the constant (daily) movements of ballast water, often taking up and discharging a quantity of water in a "Johnny Appleseed" ("Johnny Clamseed") fashion, wherever they go. Most vessels keep some type of record of ballasting operations, but there is no uniform industry standard.
- Water is carried by a vast variety of vessels and held in an impressive variety of tanks or holds. Ballast carried can range from hundreds of gallons in sailing boats and fishing boats to tens of millions of gallons in commercial cargo carriers.
- Vessels are said to be <u>in ballast</u> when they have ballast water and no cargo aboard. A vessel is <u>with ballast</u> when cargo and some ballast water are aboard. Vessels on their "ballast leg" normally carry the most ballast water. Vessels on their "cargo leg" also almost always have some ballast water, but in much smaller amounts.

Inbound vessels that have released their ballast water prior to or during cargo loading, and outbound vessels with full cargo loads, may have sufficiently little ballast on board that the mariner would report a ballast condition of "No Ballast on Board" even when some water remains. While the amount of water in a loaded vessel may be only in the hundreds or thousands of tons, from the point of view of a marine biologist these volumes of water (tens of thousands to hundreds of

thousands of gallons) may still be of sufficient quantity to support an abundant and diverse assemblage of living organisms.

It may be taken as a general rule that, with rare exception, virtually all vessels have some ballast water aboard all of the time.

- U. S. Customs and port records do not normally record ballast water amounts when vessels are "in ballast" (that is, without cargo), and usually do not record the presence of ballast water at all when vessels are "with ballast" (that is, with cargo). We refer to vessels in ballast, as reported in government records, as having acknowledged ballast; vessels with ballast have unacknowledged ballast. Cryptic ballast is unacknowledged ballast, unpumpable ballast, reported "no ballast on board" when water is present, and ballast water in vessels not recorded by published government records, such as military vessels.
- Virtually all vessels ever sampled in U.S., Canadian and Australia studies have been found to contain living organisms. There is now no question that ballast water provides a viable in-transit habitat for a wide variety of freshwater, brackish water, and marine organisms.
- The potential diversity of "ballastable biota" is often not fully appreciated. Virtually all aquatic organisms that can occur in the water, or be stirred up from bottom sediments, or dislodged off harbor pilings, can be ballasted into a vessel. Bacteria and viruses also occur in ballast tanks.
- The release of species into the environment during deballasting leads to differential survival of the species involved. The greater the temperature differences between donor (source) and receiver (target) regions the greater the probability of high mortalities. Thus most organisms from tropical ports will not survive or reproduce in colder temperate or boreal ports, and vice-versa. Exceptions occur where tropical and subtropical species transported to harbors establish reproducing populations in power plant thermal effluents, a phenomenon

well-known in Europe and North America.

However, many other variables in addition to temperature mediate the survival of newly-released organisms. Even when and where temperatures are similar between the ballast water and receiving waters, salinity, oxygen, light, food, and many other biological and ecological factors may be inhospitable or limiting. A very small number of all species released over a given period of time (for example, over several years) by most transport mechanisms (including ballast water) actually become established in new regions. As demonstrated by the zebra mussel and many other important invaders, however, only one successful invader is required to dramatically alter the environment and impact human society.

* Sediment (clay, mud, and fine sand) be taken aboard with water. These materials then settle in ballasted cargo holds and in ballast tanks. In tanks these sediments may accumulate as a mud layer, while in holds such materials may be combined with residual cargo, such as woodchip fibers and fragments, to form a bottom "sludge". In ballast tanks sediments may accumulate as a mud layer. Australian studies report the presence of shrimps, crabs, worms and many other marine organisms in these sediments, and further report that over 65 percent of cargo vessels may carry significant amounts of sediments in their ballast systems. These sediments may also contain the abundant resting stages (cysts) of microscopic toxic marine plants (dinoflagellates, members of the phytoplankton) that can cause harmful algal blooms such as red tides.

* Most vessels keep some type of record of ballasting operations, but there is no uniform industry standard.

* Based upon NABISS estimates of both acknowledged and unacknowledged water an estimate of the amount of ballast water arriving in the U.S. in vessels from foreign ports (based upon 1991 data) is as follows: There are 226 U.S. ports that receive vessel traffic from foreign ports; we examined in detail 21 of the largest of these ports. The amount of

water entering the remaining 205 ports is thus not known. We have conservatively estimated the influence of bulkers, tankers, and general cargo vessels arriving from foreign ports in cargo (unacknowledged ballast) and without cargo (acknowledged ballast) at these 205 ports by assuming that one-half (100) of these ports receives at least 10 percent (239,400 MT) of the average volume of the total acknowledged and unacknowledged ballast water received at each of the 21 ports (2,394,000 MT). There are in addition more than 25 other types of ocean-going vessels in the foreign traffic that visit U.S. waters. We assumed that all of these remaining vessels release at least 10 percent of the total volume of acknowledged and unacknowledged ballast as calculated for the 21 ports for bulkers, tankers, general cargo, and container ships; this we assume to be an underestimate.

- These estimates indicate that approximately 58,000,000 metric tons, or over 15,000,000,000 gallons of ballast water, are released every year in U.S. waters by vessels from foreign ports. This is about 42,000,000 gallons per day, or over 1,700,000 gallons an hour. In biological terms this means that over 28,000 gallons per minute of exotic aquatic organisms are released in U.S. waters from all over the world.
- In tankers acknowledged ballast is highest at Los Angeles/Long Beach, with a total of over 3,000,000 metric tons (790,500,000 gallons) arriving in 1991. Remaining ports among the top five are New Orleans, Houston/Galveston, Anchorage, and New York. In bulk cargo vessels acknowledged ballast is highest at New Orleans, with a total of over 12,000,000 MT (3,160,000,000 gallons) of water arriving in 1991, followed by Norfolk with over 9,000,000 MT (2,370,000,000 gallons) of water. The top five sites receiving the largest volumes of ballast water from general cargo traffic are New Orleans, Houston/Galveston, Miami, Tampa, and Savannah.

On the Pacific coast Los Angeles/Long Beach and Tacoma/Seattle are among

the top tanker and bulker ports, respectively, receiving ballast water (no Pacific port is high among general cargo vessels, with Los Angeles ranking seventh in this category). On the Gulf coast both Houston and New Orleans rank in the top five within all three vessel types, with Tampa also in the top five for general cargo carriers reported in ballast. On the Atlantic coast different ports rank high for quantities of ballast water received relative to vessel type: New York for tankers, Norfolk and Baltimore for bulkers, and Miami and Savannah for general cargo. On the Alaskan coast Anchorage ranks fourth overall for tankers. New Orleans, with an estimated 13,484,000 MT (3,553,000,000 gallons), thus ranks as the number 1 U.S. port in terms of acknowledged ballast received from tankers, bulk cargo vessels, and general cargo vessels. Norfolk ranks second with an estimated 9,325,000 MT (2,457,138,000 gallons) of water received. Los Angeles/Long Beach is third with 5,878,000 MT (1,548,853,000 gallons), Houston is fourth with 3,239,000 MT (853,477,000 gallons), and Baltimore is fifth with 2,834,000 gallons (746,759,000 gallons).

National "invasion hot spots" in 1993 include the Atlantic coast states of New Jersey, New York, Connecticut, Massachusetts, New Hampshire, and Maine, all with invasions during the 1980s of European and Japanese marine organisms; Los Angeles-Long Beach Harbors and San Francisco Bay, with a great many invasions in the 1980s and early 1990s of exotic aquatic organisms from Asia and the Columbia River, with invasions of Chinese plankton. In addition, many other coastal states have been subjected to red tides and other harmful algal blooms, many of which may be ballast-inoculated.

It is critical to emphasize that at any moment other sites where vast quantities of ballast water are now released may become "invasion hot spots", leading to severe economic impacts. <u>High profile sites at risk for facing potential invasions in the 1990s include the Chesapeake Bay</u>

system and the New Orleans region.

* Biological invasions in aquatic environments frequently have profound ecological, economic, and social consequences. Not all invasions have striking negative effects: some invasions have had strong positive economic impacts (such as the edible Japanese littleneck clam Venerupis philippinarum, introduced accidentally with commercial oysters in the Pacific Northwest). However, the number of nonindigenous species that have become predators and competitors, the number of invading plankton species that cause toxic algal blooms, and the number of invaders that are parasites, pathogens, and other disease-causing agents of fish, shellfish, and humans, set a striking stage for the need to manage the means by which exotic species gain access to the United States.

* A striking series of dramatic global ballast-mediated invasions have occurred in the 1980s and continue steadily into the 1990s. The Great Lakes have been invaded by the zebra mussel Dreissena and five other species of European freshwater organisms; the New Jersey and Massachusetts coasts have now been invaded by the Japanese crab Hemigrapsus sanguineus; and California, Oregon, and Washington estuaries have been invaded by many species of Chinese and Japanese marine organisms, including crustaceans, the Asian clam Potamocorbula amurensis. In 1993 alone carnivorous Russian jellyfish and carnivorous New Zealand sea slugs were discovered in San Francisco Bay. Australia was invaded by Japanese dinoflagellates and has now been invaded by devastating waves of the Japanese seastar (starfish) Asterias amurensis (a species that can be transported to America in ballast water), and the Black and Azov Seas were invaded by American comb jellyfish Mnemiopsis leidyi, leading to the virtual collapse of the anchovy fishery in the Azov Sea. A global epidemic of phytoplankton blooms is now occurring and ballast water has played a clear role in some of these events. Scores of other invasions in the 1980s have been reported as well. Many of these

organisms have had dramatic ecological impacts on biodiversity and the survival of native species.

These patterns of intensive invasions lead to the prediction that additional invasions are now occurring, and will certainly occur in the future, if the hypothesized mechanism of transport (ballast water and sediments) continues -- that is, if the faucet is not shut off or the flow significantly reduced in some manner.

* These global invasions have sparked a good deal of discussion as to why ballast water would play a greater role now than before in the dispersal of non-indigenous species. Unfortunately, predictions of what species will invade, and where and when invasions will occur, remain one of the more elusive aspects of biological invasion science. Why, for example, the zebra mussel successfully colonized Lake St. Clair and Lake Erie about 1985 (to be discovered two years later in December 1987), remains unknown. A variety of hypotheses, relative to changes in donor region, new donor regions, changes in the recipient region, invasion "windows of opportunity", changes in the dispersal vector and inoculation frequency, and stochastic massive inoculation events, all seek to contribute to our understanding of why invasions occur when they do.

* Shipping from domestic and foreign ports can also transport non-indigenous organisms to inland ports in the National Waterway System. Ocean-going deep-water vessels penetrate into major U.S. waterways other than the Great Lakes, transporting freshwater or brackish organisms up river as fouling or ballast water organisms. These sites include the Hudson River, the Chesapeake Bay, the Mississippi River, the San Francisco Bay-Delta region, and the Columbia River.

From these ports commercial barges, ferries and recreational boats can transport non-indigenous species well above areas navigable by deep water vessels. In the heartland barge and other vessel traffic can move organisms as far north as St. Paul-Minneapolis on the Mississippi River,

as well as to other deep inland ports up the Missouri, Illinois, Ohio, Cumberland, Tennessee, Tombigbee, Alabama, Arkansas, Black, Red, and Atchafalaya Rivers. Similarly, non-ocean going traffic can move organisms east of Albany up through the New York State Barge Canal, or north and east of Chesapeake Bay through the Susquehanna River. Many of these ports are now highly modified urbanized-industrialized environments conducive to invasions by non-indigenous species. There are thus numerous portals into the American heartland. As "back doors" to the Great Lakes and other inland water bodies, these corridors remain conduits for invasions.

* The philosophy of ballast water and sediment management is as follows:

> ballast management should seek to prevent the introduction of all organisms, ranging from bacteria and viruses to plants, invertebrates, fish, and all other entrained life.

An important corollary to this philosophy is that no one option or alternative is likely to satisfy this management objective. It is not appropriate to single out one alternative as "the most" likely or viable -- rather, a synthetic approach, choosing a number of alternatives simultaneously from a broad menu of possibilities, will eventually maximize the strength of ballast management.

* NABISS identified over 30 control alternatives (Appendix I). Those alternatives identified as most promising for further study are:

Prevention of Organism Intake

(Ballasting Micromanagement: do not ballast in "Global Hot Spots" (sites of major invasions and harmful algal blooms); do not ballast water with high sediment loads; do not ballast in areas of sewage discharge or known disease incidences; do not ballast at certain sites at certain times of year; do not ballast at night)

Removal and/or Extermination of Organisms

(microfiltration, ultraviolet treatment, ultrasonics treatment, thermal

treatment, altering water salinity, sediment management)

Overall Ballast Water Operations

(deballast/no reballasting; exchange; deballast or exchange in designated back-up zones; discharge (offload) to reception vessel; non-discharge of water; return to sea: deballast/no reballasting or exchange)

These approaches now require critical and immediate field testing, and coordination with any testing and evaluation programs being conducted by other nations.

* Numerous complications attend the establishment of ballast water management systems. Ballast pathways are replete with exceptions, novelties, and irregularities. By the very nature of the thousands of possible combinations of vessels, tanks, and ballast histories, ballasting management -- as with all quarantine systems -- possesses potentially numerous holes in the dike. Integral to an understanding of any quarantine system is that the system is a filter, but not an absolute barrier.

* Ballast water may be released as vessels pass along coastlines, and coastal traffic may carry invading species from large ports to smaller ones, such that no coastal sites, whether they receive direct international shipping or not, are immune to vessel-mediated invasions.

Appendix I.
Ballast Water and Sediment Management Options

I ON OR BEFORE DEPARTURE FROM PORT-OF-BALLAST WATER ORIGIN

Water Supply: Uptake

1. Specialized Shore Facility Provides Treated Salt or Fresh Water
2. Port Provides City Fresh Water

Prevention of Organism Intake: Ballasting Micromanagement

3. Site: Do Not Ballast in "Global Hot Spots"
4. Site: Do Not Ballast Water with High Sediment Loads
5. Site: Do Not Ballast Water in Areas of Sewage Discharge or Known Disease Incidences
6. Site/Time: Do Not Ballast at Certain Sites at Certain Times
7. Site/Time: Do Not Ballast at Night

Prevention of Organism Intake: Mechanical

8. Filtration

Extermination of Organisms Upon Ballasting (Ballast Treatment)

9. Mechanical Agitation
   a. Water Velocity
   b. Water Agitation Mechanisms
10. Altering Water Salinity
   a. Add Fresh Water to Salt Water
   b. Add Salt Water to Fresh Water
11. Optical: Ultraviolet Treatment
12. Acoustics (Sonic): Ultrasonics Treatment

II ON DEPARTURE AND/OR WHILE UNDERWAY (EN ROUTE)

Extermination of Organisms After Ballasting
(while at Port-of-Origin or while underway, but before arrival at destination port)

Active Disinfection (Ballast Treatment):

13. Tank Wall Coatings
14. Chemical Biocides
15. Ozonation
16. Thermal Treatment
17. Electrical Treatment (including microwaves)
18. Oxygen Deprivation
19. Filtration/Ultraviolet/Ultrasonics Underway
20. Altering Water Salinity: Partial Exchange

Passive Disinfection:

21. Increase Length of Voyage
22. Exchange (Deballast/Reballast)
23. Sediment Removal and at Sea Disposal

Deballasting Only

24. Deballast/No Reballasting

III BACK UP ZONES

25. Exchange or Deballast

IV ON ARRIVAL AT BALLAST DISCHARGE DESTINATION PORT

Water Supply: Discharge

26. Shore Facility Receives Treated and Untreated Water

Prevention of Discharge to Environment

27. Discharge to Existing Sewage Treatment Facilities
28. Discharge to Reception Vessel
29. Sediment Removal and Onshore Disposal
30. *In situ* Extermination of Organisms Upon Arrival (Options 8, 11, 14)

Non-Discharge

31. Non-Discharge of Ballast Water

V RETURN TO SEA: EXCHANGE WATER

32. Vessel Returns to Sea and Undertakes Exchange

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SCIENCE

Ecological Roulette: The Global Transport of Nonindigenous Marine Organisms

James T. Carlton and Jonathan B. Geller

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Ocean-going ships carry, as ballast, seawater that is taken on in port and released at subsequent ports of call. Plankton samples from Japanese ballast water released in Oregon contained 367 taxa. Most taxa with a planktonic phase in their life cycle were found in ballast water, as were all major marine habitat and trophic groups. Transport of entire coastal planktonic assemblages across oceanic barriers to similar habitats renders bays, estuaries, and inland waters among the most threatened ecosystems in the world. Presence of taxonomically difficult or inconspicuous taxa in these samples suggests that ballast water invasions are already pervasive.

Biological invasions are a great threat to the integrity of natural communities of plants and animals and to the preservation of endangered species (*1*). Most invasion studies have focused on terrestrial and freshwater systems in which one or a few successful invaders have had a catastrophic impact on native species (*2*). Island ecosystems, such as New Zealand and the Hawaiian Islands, have in particular been devastated by the invasion of nonindigenous species (*1–3*). Invasions in marine systems have been less studied (*4*), but are of such magnitude that marine invasions may be leading to profound ecological changes in the ocean.

Any mechanism for rapidly transporting large volumes of water containing plankton from shallow, coastal waters across natural oceanic barriers has the potential to facilitate massive invasions of entire assemblages of neritic marine organisms. Such a mechanism exists in the transport of ballast water and plankton by ocean-going ships (*5*), a dispersal mecha-

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nism that has no analog in terrestrial ecosystems. We report here a survey of plankton in ballast water.

Ships have used water as ballast regularly since the 1880s, drawing ambient water into ballast tanks and floodable holds for balance and stability (6). This water is discharged while under way and at subsequent ports-of-call as cargo is loaded (7). Water taken aboard may contain any planktonic organisms in the water column (8). Thus, rich plankton assemblages may be entrained by vessels and then released within days or weeks on a continent or island thousands of kilometers away.

Table 1. Frequency of occurrence and abundance of organisms in ballast water from ships arriving from Japan to the Port of Coos Bay, Oregon, after a transoceanic trip of 11 to 21 days [average 15.1 (SD 1.9) days]. Specificity of identification depended on the phylum or division considered.

Taxon	Species (n)	Ships (%) in which taxon was				Adult	
		Abundant (>100/ replicate)	Common (10 to 100/ replicate)	Rare (<10/ replicate)	Present	Habitat*	Trophic group†
Crustacea							
Cirripedia	5	11.0	31.0	41.0	83.0	HE	S
Harpacticoida	5	17.0	29.0	28.0	74.0	HE, SE, PL, EB	SC, H
Calanoida and Cyclopoida	25	61.6	25.7	11.3	98.6	PL, SE	C, H, SC
Decapoda	14	3.1	4.4	40.8	48.3	SE, HE, EB	O, H, C, D, SC, S
Euphausiacea	1	0	0	1.3	1.3	PL	O
Stomatopoda	1	0	0	2.5	2.5	HE, SE	C
Cumacea	3	0.6	1.3	11.3	13.2	SE, I, PL	D
Mysidacea	2	0.6	5.0	28.0	33.6	SE, PL	H, D
Isopoda	4	0	1.3	32.1	33.4	HE, EB	SC, O, D, H, P
Caprellidea	1	0	0	2.5	2.5	EB	C, O
Gammaridea	8	0	1.4	22.0	23.4	SE, HE	H, D, S
Hyperiidea	1	0	0	10.7	10.7	PL	C
Ostracoda	1	0	0	2.5	2.5	HE, SE, PL	H
Cladocera	1	0	0	0.6	0.6	PL	H
Chelicerata							
Acarina	1	0	0	5.0	5.0	HE	D, SC
Echinodermata							
Asteroidea	1	1.2	1.9	11.3	14.4	HE, SE	C, SC
Echinoidea	2	0.6	1.9	15.0	17.5	HE, SE	H, SC
Ophiuroidea	1	0	0	3.1	3.1	HE, SE	D, SC
Holothuroidea	2	0	0	5.7	5.7	I, HE, SE	D, S
Chordata							
Urochordata	10	0.6	0	5.7	6.3	HE, EB	S
Pisces	2	0	0	3.2	3.2	PL	C
Hemichordata							
Enteropneusta	1	0	0	0.7	0.7	I	D
Chaetognatha	3	3.1	14.5	29.5	47.1	PL	C
Phoronida	1	0.6	3.8	24.5	28.9	HE, SE	S
Bryozoa	3	3.1	5.7	20.8	29.6	HE, EB	S
Annelida							
Spionidae	11	23.9	40.3	20.7	84.9	SE, HE	D, H, C, S
Polynoidae	3	1.2	3.1	38.0	42.3	SE, HE	D
Other Polychaeta	28	5.0	18.8	45.3	69.1	I, EB, SE, HE	SC, C, S
Hirudinea	1	0	0	0.7	0.7	PL	P
Platyhelminthes	33	0.6	8.8	55.3	64.7	SE, HE	C, SC, P
Nemertea	1	6.3	0	5.7	12.0	SE, HE, I	C
Mollusca							
Bivalvia	9	22.0	23.9	25.2	71.1	HE, SE, I	D, S
Gastropoda	10	2.5	16.4	42.8	61.7	SE, HE	D, SC, H, C
Sipuncula	1	0	0	2.5	2.5	SE, HE	D
Nematoda	1	0	0	9.4	9.4	SE, HE, EB	D, SC
Rotifera	1	0	0	8.2	8.2	PL	O, H
Cnidaria							
Anthozoa	2	0	0	1.3	1.3	HE	S, C
Scyphozoa	1	0	0	1.9	1.9	PL	S, C
Hydrozoa *Obelia*	1	0	1.4	21.4	22.8	HE, EB, PL	S, C
Other Hydrozoa	21	0	0.6	19.5	20.1	HE, EB, PL	S, C
Radiolaria	2	0	0	18.9	18.9	PL	C, O
Foraminifera	3	0.6	2.5	6.3	9.4	EB, HE, SE, PL	C, D, SC
Tintinnida	2	15.7	11.3	16.3	43.3	PL	C, SC
Other ciliata	4	‡	‡	‡	‡		
Dinoflagellata	4	6.7	11.4	9.5	27.6	PL	PP
Diatomacea	128	54.7	20.7	17.6	92.4	SE, HE, PL	PP
Chlorophyta	2	0	0	3.8	3.8	SE, HE	PP
Rhodophyta	2	0	0	1.2	1.2	SE, HE	PP
Zosteraceae	1	0	0	0.7	0.7	SE	PP

*EB, epibiotic (living on other organisms); HE, hard bottom epifaunal; I, infaunal, PL, planktonic, SE, soft bottom epifaunal †C, carnivore, D, deposit feeder; H, herbivore; O, omnivore, P, parasite, PP, primary producer, S, suspension feeder, SC, scavanger ‡Ciliate abundance not estimated

We sampled ballast water from 159 cargo ships in Coos Bay, Oregon. The ships and their ballast water originated from 25 Japanese ports (9). Plankton from these vessels included 16 animal and 3 protist phyla, and 3 plant divisions (Table 1). All major and most minor phyla were represented (10), including 47 ordinal or higher taxa and a minimum of 367 distinctly identifiable taxa (11). The supraspecific diversity demonstrates the wide taxonomic spectrum represented and emphasizes the broad implications of this phenomenon (12).

All major marine trophic groups were represented (Table 1) including carnivores, herbivores, omnivores, deposit feeders, scavengers, suspension feeders, primary producers, and parasites, although the last were rare. Taxa characteristic of most temperate shallow-water marine communities were represented, including those from infaunal, soft and hard bottom epifaunal, epibiotic, and planktonic habitats. The bal-

Table 2. Examples of recent invasions probably mediated by ballast water.

Higher taxon	Taxon	Species	Native distribution	Introduced to	Year introduction first recognized (reference)
Dinoflagellata		*Alexandrium catenella*	Japan	Australia	1986 (*6*)
		Alexandrium minutum	Europe?	Australia	1986 (*6*)
		Gymnodinium catenatum	Japan	Australia	1986 (*6*)
Cnidaria	Scyphozoa	*Phyllorhiza punctata* (*,†)	Indo-Pacific	California	1981 (*28*)
	Hydrozoa	*Cladonema uchidai* (†)	Japan, China	California	1979 (*23*)
Ctenophora		*Mnemiopsis leidyi*	Western Atlantic	Black Sea	1987 (*26*)
Annelida	Oligochaeta	*Teneridrilus mastix* (*)	China	California	1984 (*29*)
	Polychaeta	*Desdemona ornata* (*)	South Africa, Australia	Italy	1986 (*30*)
		Marenzelleria viridis	U.S. Atlantic	Germany	1983 (*31*)
Crustacea	Cladocera	*Bythotrephes cederstroemi*	Europe	Great Lakes	1984 (*32*)
	Mysidacea	*Rhopalophthalmus tattersallae* (*)	Indian Ocean	Kuwait	1981 (*33*)
		Neomysis japonica	Japan	Australia	1977 (*34*)
		Neomysis americana (*)	U.S. Atlantic	Argentina, Uruguay	1979 (*35*)
	Cumacea	*Nippoleucon hinumensis*	Japan	California	1980? (*23*)
				Oregon	1979 (*23*)
	Copepoda	*Pseudodiaptomus inopinus*	Asia	Columbia River	1990 (*36*)
		Pseudodiaptomus marinus	Japan	California	1986 (*37*)
		Pseudodiaptomus forbesi	China	California	1987 (*37*)
		Sinocalanus doerrii	China	California	1978 (*38*)
		Oithona davisae	Asia	California	1979 (*39*)
				Chile	1983 (*40*)
		Limnoithona sinensis	China	California	1979 (*39*)
		Centropages abdominalis	Japan	Chile	1983 (*41*)
		Centropages typicus	U.S. Atlantic	Texas	1985 (*42*)
		Acartia omorii	Japan	Chile	1983 (*40*)
	Decapoda: Brachyura	*Hemigrapsus sanguineus*	Asia	New Jersey	1988 (*43*)
		Charybdis helleri	Indo-Pacific, Israel	Colombia (Caribbean)	1987 (*44*)
	Decapoda: Caridea	*Salmoneus gracilipes* (*)	Japan, Micronesia	California	1986 (*45*)
		Hippolyte zostericola (*)	Western Atlantic	Colombia (Atlantic)	1984 (*46*)
		Exopalaemon styliferus (*)	Indonesia, India	Iraq, Kuwait	1983 (*47*)
Mollusca	Gastropoda	*Tritonia plebeia*	Europe	Massachusetts	1983 (*4*)
	Bivalvia	*Potamocorbula amurensis*	Asia	California	1986 (*23*)
		Dreissena polymorpha	Eurasia	Great Lakes	1988 (*24*)
		Dreissena sp.	Eurasia	Great Lakes	1990 (*25*)
		Rangia cuneata (*)	Southern U.S.	New York	1991 (*48*)
		Theora fragilis	Asia	California	1982 (*23*)
		Musculista senhousia (†)	Japan	New Zealand	1980 (*49*)
				Australia	1982 (*49*)
		Ensis americanus	U.S. Atlantic	Germany	1979 (*50*)
Ectoprocta		*Membranipora membranacea* (*)	Europe	New Hampshire, Maine	1987 (*51*)
Pisces		*Gymnocephalus cernuus*	Europe	Great Lakes	1987 (*52*)
		Proterorhinus marmoratus	Black Sea	Great Lakes	1990 (*53*)
		Neogobious melanostomus	Mediterranean	Great Lakes	1990 (*53*)
		Butis koilomatodon	Indo-west Pacific	Nigeria, Cameroon	1983 (*54*)
				Panama Canal	1972 (*54*)
		Rhinogobius brunneus	Japan	Arabian Gulf	1987 (*55*)
		Mugiligobius sp.	Taiwan, Philippines	Hawaii	1987 (*56*)
		Sparidentex hasta	Arabian Sea	Australia	1985 (*57*)
		Parablennius thysanius	Philippines, Indian Ocean	Hawaii	1971 (*58*)

*Suggested herein as a ballast-mediated invasion. †An alternative means of dispersal includes transport as external fouling on ships' hulls. Here we suggest that transport as ephyrae (for Scyphozoa) and hydromedusae (for Hydrozoa) are as probable as transport as fouling polyps.

last biota included meroplankton (organisms spending part of their life cycle in the water column), holoplankton (spending all of their lives in the water column), demersal plankton (benthic species that vertically migrate into the water), and tychoplankton (suspended benthic organisms). Ballast water therefore acts as a phyletically and ecologically nonselective transport vector. Certain taxa occurred in high densities: we estimated copepod densities were greater than 1.5×10^3 per cubic meter and spionid polychaete larvae, barnacle nauplii, and bivalve veligers greater than 2×10^2 per cubic meter (*13*).

Despite the lack of selectivity, certain taxa predominate. Five phyla accounted for more than 80% of taxa recorded: crustaceans (31% of all taxa present), polychaete annelids (18%), turbellarian flatworms (14%), cnidarians (11%), and mollusks (8%). Taxa found in many or most vessels included copepods (present in 99% of ships), polychaetes (89%), barnacles (83%), bivalve mollusks (71%), flatworms (65%), diatoms (93%), gastropod mollusks (62%), decapod crustaceans (48%), and chaetognaths (47%).

For some taxa the number of released individuals may vary greatly among ships, whereas the frequency of release may be high (Table 1). Gastropods were abundant in only 2.5% of ships but present in 62% of ships sampled, decapods were abundant in only 3.1% and present in 48% of ships, spionids were abundant in 24% of ships and present in 85% of ships, and nonharpacticoid copepods were abundant in 61% of ships and present in 98% of ships.

Behavioral and life history traits make some taxa less prone to being transported by ballast water. Taxa with both a strictly benthic life-style and with brooded or crawl-away young [for example, brooding gastropods, bivalves, and anthozoans (*14*)] would rarely be in the water column when ballast is pumped on board. Similarly, organisms with an extremely short planktonic life (sponges, direct-developing bryozoans, and ascidians) would rarely be caught. Nektonic organisms (such as fish) may be able to resist either the water intake pressures of the ballast pump or may be able to avoid the plankton net. However, any taxa likely to attach to algae (*15*) could be taken up along with the drift algae (*16*, *17*).

In the past 20 years, numerous aquatic invasions have occurred (Table 2). Many of these now appear to be related to ballast water transport (*18*). The taxa of these documented invasions (Table 2) are all represented (except comb jellies) in our samples of ballast water (Table 1). However, some higher taxa frequently found in ballast water have not been often reported as invasive species. Conversely, some higher taxa that are reported relatively frequently as invaders were not found frequently in our samples. Although we recognize that high frequency of release does not necessarily lead to successful invasions, we suggest that there have been far more introductions of polychaetes, flatworms, and diatoms than have been reported. Invasions of intensely studied larger-size animals (such as fish, mollusks, and decapods) are more apparent and thus more noticeable. We predict that more invasions of both large and small organisms will be recognized as susceptible regions are investigated and that new invasions will be discovered in well-studied regions (*19*).

Knowledge of species' natural geographic distributions is of paramount importance for interpreting patterns in ecology, evolution, and biogeography. Unfortunately, the systematics of most marine taxa are far from complete, and the discovery of previously unrecognized species in regions impacted by ballast water release (almost all coastal zones of the world) must now be viewed critically as potential invasions (*20*). Conversely, for easily identified species, unrecognized historical transport may have led to false conclusions of natural cosmopolitanism. Thus, many introduced species may be cryptic, having invaded and gone unrecognized or been mistaken as native species. Both these situations confound our understanding of historical patterns of dispersal, gene flow, and speciation: geographic barriers to dispersal and gene flow are readily breached by ballast water transport. Similarly, we must now recognize that the composition of aquatic communities may be influenced by both recognized and cryptic invasions.

Ships take up and release ballast water in bays, estuaries, and inland waters and then release this water into similar environments around the world. Many of these bodies of water are disturbed by the effects of extensive urbanization (*21*), rendering them especially susceptible to invasions (*22*) that further alter community structure and function. The invasion of the Asian clam *Potamocorbula amurensis* in San Francisco Bay (*23*), the zebra mussels *Dreissena polymorpha* and *Dreissena* sp. in the Laurentian Great Lakes (*24*, *25*), and the comb jelly *Mnemiopsis leidyi* in the Black Sea (*26*) are dramatic examples of the catastrophic impact of ballast water introductions. The ecological roles and impacts of invading species can only be partially predicted from knowledge of their biology and ecology in donor regions (*2*). For these reasons, bays, estuaries, and inland waters with deep water ports—marine analogs of despoiled, highly invaded oceanic islands—may be among the most threatened ecosystems on the planet (*27*).

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6. Ballast water may be fresh, brackish, or marine, depending upon the ballasting site. Sediments may also be entrained; the release of such sediments has been linked to the introduction of toxic dinoflagellates (in their benthic cyst stage) in Australia [G. M. Hallegraeff and C. J. Bolch, *Mar. Pollut. Bull.* **22**, 27 (1991), G. M. Hallegraeff, *Phycologia* **32**, 79 (1993)], (*57*).
7. Ballast water may also be taken aboard and discharged in many other patterns. For example, offshore water may be ballasted in one ocean and deballasted in another ocean, which would result in the movement of oceanic taxa in addition to neritic taxa.
8. Larger (>2 cm) organisms (such as fish) may fail to pass through the intake grates or may be destroyed by the impeller pump blades.
9. Ships were sampled from 1986 to 1991. Five to six vertical quantitative hauls were made in each vessel using an 80-μm mesh, 0.5-m-diameter plankton net towed at 0.5 m s^{-1} in 10 to 20 meters of ballast water of floodable cargo holds. Samples were examined alive under a stereomicroscope to ensure the inclusion of fragile specimens. All samples were preserved and retained. Specimens of many taxa were cultured until they grew to a size that permitted identification. Information on the volume, source, and age of ballast water was obtained. Cargo holds sampled contained an average of 1.09×10^4 (SD = 2.7×10^3) metric tons (= 1.09×10^7 liters, SD = 2.7×10^6) of water; total ballast water on board averaged 2.01×10^4 (SD = 6.4×10^3) metric tons (= 2.01×10^7 liters, SD = 6.4×10^6) of water.
10. Two relatively common marine phyla not found in our samples are the Porifera (sponges) and Ctenophora (comb jellies). The absence of ctenophores may reflect a bias against extremely fragile taxa. Alternatively, ctenophore distribution is often temporally and spatially uneven [K. Mountford, *Estuarine Coastal Mar. Sci.* **10**, 393 (1980), E. Deason, *Estuarine Coastal Shelf Sci.* **15**, 121

(1982)] and their absence may reflect chance. The planktonic larvae of sponges are short-lived and may survive only short voyages.
11. True species diversity in these samples is underestimated because larval and postlarval forms of many species are morphologically indistinguishable. Also, animal, plant, and protist taxa smaller than 80 μm (the size of the plankton net mesh) were not efficiently retained.
12. We estimate (assuming 20 to 30 taxa per vessel, and several thousand ships out of a world fleet of 35,000 with ballast water at sea at any given time) that, on any one day, several thousand species may be in motion in ballast water "conveyor belts" around the world. Therefore, comparing known invasions (Table 2) with any particular ballast sample may rarely reveal the same taxa, underscoring the importance of recognizing this phenomenon at a supraspecific level.
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16. Organisms with a short larval phase can be entrained in ballast water and then settle. We found metamorphosed ascidians (1 to 2 mm) settled on floating wood chips, and, in five ships that had completed voyages of 13 to 16 days, we found unattached ascidian tadpoles but no adults. Although we found few fish in our samples, more than 20 ship's captains in the Great Lakes, and on the U.S. Atlantic, Gulf, and Pacific coasts, have reported to us live fish in ballast water tanks.
17. Freshwater ballast transferred to other freshwater endponts (such as from Europe to the Laurentian Great Lakes, or vice versa) may transfer encysted stages of many taxa (such as sponge gemmules and bryozoan statoblasts). Such stages remaining in ship's ballast sediments after open ocean exchange may resist saltwater immersion.
18. The recent increase in invasions caused by ballast water may be due to a variety of factors, including increases in the size, number, and speed of ships (4, 5).
19. We expect that several of the six species of Asian copepods now recognized on the Pacific coast of North America will also be found in eastern Australia, a region that receives large volumes of ballast water from the same sources in Japan and China as does the North American Pacific coast.
20. Over 50 examples are now known where introduced species were mistakenly described as "new" species, some several times from different places around the world (J. T. Carlton, in *San Francisco Bay: The Urbanized Estuary*, T. J. Conomos, Ed. (American Association for the Advancement of Science, Washington, DC, 1979), pp. 427–444; J. W. Chapman and J. T. Carlton, *J. Crustacean Biol.* **11**, 386 (1991); J. T. Carlton, unpublished results).
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Testimony of:
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Before a Joint Hearing of the:
Merchant Marine and Fisheries Subcommittees on Merchant Marine; Fisheries Management; and Coast Guard & Navigation

Room 1334, Longworth House Office Building
10:00 a.m., October 27, 1993

1.

Mr. Chairmen and members of the subcommittees, my name is Bruce Shupp. Since 1980 I have been Chief of the Bureau of Fisheries (freshwater) within New York's Department of Environmental Conservation. Since New York is a Great Lakes state and a cooperator state within the Great Lakes Fishery Commission, our agency has been involved in ballast water regulation and management since it became an issue in 1988. Therefore, we are pleased to testify in support of the Ballast Control Act which will fund studies to determine the safest and most effective methods of ballast water management to prevent introduction of nonindigenous organisms into the receiving water environment.

My purpose today is to emphasize the need: to expedite the research and development studies called for in the Ballast Control Act; to quickly adopt the results; and to rapidly deploy the technology. I will also try to illustrate that preventing the introduction of nonindigenous species is far superior to attempting to control them once they are established.

Exhortations of concern about the potential negative impacts of introducing more nonindigenous species to North America's aquatic ecosystems are not simply "crying wolf". This is neither paranoia, nor misdirected fear of the unknown. The introduction of nonindigenous plants and animals (including things known as diseases) is much more than an academic concern. Major changes to aquatic ecosystems can and have occurred. They have and will

greatly influence the way we use these systems, the benefits we derive from them and the costs to society to extract those benefits.

The urgency of the situation seems obvious. During just the last decade, new species have appeared in the Great Lakes ecosystem with visible impact. The public doesn't need scientists to tell them these species are present. I'm referring primarily to the spiny water flea (Bythrotrephes cederstroemi), zebra mussels (Dreissena polymorpha) and ruffe (Gymnocephalus cernua). The spiny water flea, or B.C. for short, discovered in 1984, quickly displaced native zooplankton to become such a dominant species in several of the Great Lakes that they accumulated on anglers' lines. Zebra mussels, discovered as two-year olds in Lake St. Clair in 1988 (IJC and GLFC, 1990), have now expanded their North American range to include the entire Great Lakes system, the Mississippi River, Arkansas-White-Red Rivers, Ohio River, Mohawk River-Hudson River drainage,and the Tennessee-Cumberland River systems (USFWS 1993). It is believed that this rapid expansion was vectored by barge traffic in navigable waterways, but eventually other vectors will introduce zebra mussels to the majority of surface waters in the eastern United States.

Damage from abundant zebra mussel colonies has been well documented (Mills, etal, 1993). They physically displace native mollusk species, clog water intake structures, foul vessel hulls

and motors and affect navigation aids. The least understood but potentially most damaging impact from zebra mussels is the shift of energy within the trophic levels of the aquatic ecosystem, from pelagic or midwater areas to the benthic or bottom environment. It is the midwater area where most of the currently desirable species of fish, such as salmon, trout, perch, bass, walleye, etc., make their living. If the biological productivity of the midwater area is significantly reduced, these desirable fish species will also decline. In 1991, freshwater anglers spent $15.1 billion (US Dept. of Interior etal, 1993) nationwide. While I won't attempt to predict the economic losses from displaced angling activity due to the introduction of zebra mussels, it could reach several billion dollars annually.

Depending on whose estimate you use, over the next decade costs to deal with just the physical and engineering problems associated with zebra mussel colonization will approximate $4 to $8 billion (McCommons, 1990). It's important to emphasize these are costs to adapt our culture's existing water uses to the presence of this new organism. This is not a cost to "control" the organism. We are not controlling zebra mussels. At best we are slowing the expansion of its range as we adapt to it.

New York has a draft "Nonindigenous Aquatic Species Management Plan" (Sinnott and Paul, 1993). The four goals of the plan are essentially to reduce the potential for new nonindigenous species

introductions; reduce the spread of nonindigenous species that already exist within New York; minimize the damage from those nonindigenous species that have been introduced; and educate the public on the importance of preventing future introductions. This is a good plan. It does as much as is now presently feasible for New York State to attempt to do. The estimated cost of implementation is about $350,000 annually. But, the New York plan does not attempt to control zebra mussels. We do not, and will not in the near future, have the technology to stop the spread of this organism.

Ruffe, a small fish of the European perch family, was first found in 1987 and now has established an abundant reproducing population in the Duluth Harbor area of western Lake Superior (Great Lakes Fishery Commission, 1992). Expansion of its range from this location has apparently been retarded due to the cold water temperatures of Lake Superior. Once the ruffe reaches eastern Lake Superior, and it is expected to achieve that in several years, the ultimate dispersal will be potentially similar to that of the zebra mussel -- virtually the entire United States east of the continental divide will be affected.

The ruffe is a small fish with no commercial or recreational value (Busiahn, 1993). As the ruffe expanded its population in Duluth Harbor, native species have declined. It is expected that expansion of ruffe throughout North America will result in a very

degraded fish community and fishery. No species-specific control exists to eradicate the ruffe. Great Lakes states and federal fisheries managers are debating the value of using non-selective chemical pisticides to partially kill a significant portion of the breeding ruffe population in western Lake Superior (Busiahn, 1993). The objective would be to delay range-expansion for a decade or so with hopes that a more specific and effective control technology can be developed. This strategy has honorable intent, but it represents desperation management. We certainly are not now in control of ruffe expansion and we may never be. The ruffe is another potential multi-billion dollar annual insult to the existing sportfisheries of North America.

The best example of how inadequate our society is at initiating control over an unwanted indigenous aquatic organism is the sea lamprey. Although ballast water figures prominently in the introduction of spiny water flea, zebra mussel and ruffe, an earlier "wave" of introductions accompanied the canal-building era of the 19th century. Sea lamprey are one of the species that gained access to the Great Lakes via this route. They gained access from Lake Ontario to Lake Erie in 1921 via modifications to the Welland Canal and reached Lake Superior by 1946. Sea lamprey feed on the blood and body fluids of large fish. Once established in the Great Lakes they initially decimated native lake trout populations. They also prevented successful restoration of lake

trout and development of trout and salmon fisheries derived from stocking hatchery-reared fish.

The destruction of lake trout stocks by sea lamprey was a major impetus for the 1955 "Convention on Great Lakes Fisheries" between the United States and Canada. This international agreement created the Great Lakes Fishery Commission (GLFC) and mandated that it "...formulate and implement a comprehensive program for the purposes of eradicating or minimizing ... sea lamprey populations..."

The sea lamprey is rather unique among nonindigenous aquatic nuisance species that have caused great ecological and economic damage in the Great Lakes. Its life cycle predisposes it to effective control. Sea lamprey spawn only in certain tributaries with very specific, high quality habitats. Larval sea lamprey live in sediments within these tributaries for several years before they transform into parasitic adults and migrate to the lakes. These larvae, in the stream environments, are highly vulnerable to treatment with a lampricide known as TFM.

The GLFC has developed effective technologies to interrupt the life cycle of sea lamprey in tributaries. The application of these technologies has markedly reduced sea lamprey populations in most areas of the Great Lakes. New technologies offer the promise of more effective control with less reliance on lampricides. Sea

lamprey control has enabled the return of vibrant trout and salmon fisheries, which are the backbone of a Great Lakes sportfishing industry estimated to have a value of from $2 to $4 billion annually (Merchant Marine and Fisheries Committee Hearing Record, 1991).

Despite these technological achievements and our capability to effect control over this organism, sea lamprey control is only a partial success. Why? Because we have not been willing to invest the additional money to maximize control.

The expansion of sea lamprey in the St. Mary's River where existing control technologies cannot be applied in a cost effective manner has resulted in such an increase in sea lamprey abundance in northern Lake Huron that control is considered to be effectively nonexistent there. The development of promising new control technologies that could be effective in the St. Mary's River and elsewhere is being delayed or shelved entirely due to inadequate funding. Since the late 1980s the capability of the GLFC to conduct its scheduled sea lamprey control activities has been endangered on an annual basis, requiring lobbying efforts and ad hoc Congressional bail-outs to maintain just the very basic control program. Again in 1993, the GLFC has informed cooperating state/provincial natural resource management agencies that in 1994 it will be unable to conduct scheduled sea lamprey control activities in much of the Great Lakes basin, including all of Lake

Erie and Lake Ontario, unless it receives an increased appropriation.

The GLFC could conduct its sea lamprey control program effectively, including research to develop and bring new control technologies on-line, with an annual budget of only $20.5 million. However, the annual budget of the GLFC for FY 93 is only $11.2 million, derived from appropriations from both the U.S. and Canadian governments. Sea lamprey control accounts for 95% of the GLFC FY 93 budget, or, $10.6 million. The impending crisis in 1994 is exacerbated by a requirement for $5 million to conduct studies needed to support the re-registration of TFM in the U.S. (Great Lakes Fishery Commission, 1993).

There is no indication from either the U.S. or Canadian governments that this level of funding will be forthcoming. It seems more likely that the GLFC capability to control sea lamprey in the Great Lakes basin will continue to be propped-up at a barely effective level or allowed to further deteriorate because of the inability or unwillingness of the U.S. and Canadian governments to adequately fund GLFC sea lamprey control. Recurring annual budget crises seem likely to continue.

Other destructive or potentially destructive nonindigenous aquatic nuisance organisms extant in the Great Lakes are far less vulnerable to control than sea lamprey because no stage of their

life cycles is confined to accessible areas. Control programs for organisms like zebra mussels or ruffe, if ever feasible, will be enormously expensive and require a level of political will that has not been recently demonstrated for the sea lamprey.

Thus, with the exception of sea lamprey, the solution for dealing with ecological and economic nonindigenous species may not be to base future national strategies on control. Our record is not impressive in that area. Likewise, we will spend billions to prevent water use losses from zebra mussels and could lose billions in combined fishery benefits from combined impacts from zebra mussels and ruffe. Therefore, as the Ballast Control Act recommends, we must expeditiously invest wisely in research on how to prevent the introduction of new organisms from ballast discharge. Those new organisms may even pose a more devastating and costly threat to our aquatic resources than the losses to be absorbed from the recent exotic species introductions.

Mr. Chairman, I thank you personally and on behalf of my agency and the people of the State of New York for the opportunity to give our views on this important legislation.

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Testimony by:
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Lake Carriers' Association

U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON MERCHANT MARINE AND FISHERIES
Subcommittee on Merchant Marine
Subcommittee on Fisheries Management
Subcommittee on Coast Guard and Navigation

HEARING ON BALLAST EXCHANGE CONTROL ACT

October 27, 1993

Lake Carriers' Association represents 15 U.S.-flag Great Lakes fleets which have a combined total of 62 vessels with a per-trip capacity of 1,819,383 gross tons of bulk cargo. These commercial vessels range in length from 383 to 1,013 feet and comprise more than 98 percent of the tonnage of U.S. Great Lakes vessels engaged in the domestic trade. These vessels can carry more than 120 million tons of cargo each year.

Lake Carriers' Association is pleased to share our experiences with ballast water management in the hopes that they can assist these Committees in the development of legislation to study the problems related to the introduction of non-indigenous nuisance species into the Great Lakes and evaluate and test promising ballast water management technologies and practices. We support this legislative process. No doubt some of our member fleets will be willing to participate in joint public/private ventures to demonstrate the most promising technologies or procedures.

As you may already know, Lake Carriers' Association, in conjunction with other maritime interests on the Great Lakes, recently instituted a Voluntary Ballast Water Management Plan (attached) to control the spread of the European River Ruffe from its current habitat in Western Lake Superior. We and our partners in this endeavor are, in the words of U.S. Fish and Wildlife Service, "the first maritime association in North America to propose a voluntary ballast water management strategy."

Why did Lake Carriers' Association develop the Voluntary Ballast Water Management Plan. The answer is found in the Association's Environmental Policy. The members of Lake Carriers' Association are pledged to "include sound environmental polices, programs, and practices as an essential element in every vessel's daily operation and in the overall fleet management." Lofty words indeed, but if the proof is in the pudding, then our Voluntary Ballast Water Management Plan is very edible.

A commitment to the Environment is especially important for those who work on or along the shores of the Great Lakes. The Great Lakes are the source of drinking water for 25 million North Americans. Sport and commercial fishing and tourism contribute billions to the U.S. and Canadian economies. We who are involved in the movement of nearly 200 million tons of dry- and liquid- bulk cargo each year recognize that we must share in the protection of these fresh water oceans. For that reason, when we identified the problem the Ruffe represented, we responded as quickly and to the degree that current knowledge and technology allowed. We did not cause the problem, but we know we must be part of the solution to mitigate the problem.

Let me briefly review the situation concerning the European River Ruffe on the Great Lakes. This fish was first discovered in Duluth/Superior Harbor in 1987. Scientists believe the Ruffe was introduced by a discharge of ballast water from an ocean-going vessel in 1982 or 1983.

The Ruffe is a very aggressive feeder and lacking in natural predators. As a result, it is now, just 6 years after its discovery and identification, the most abundant fish in the Duluth/Superior Harbor. Furthermore, the Ruffe is migrating east along the south shore of Lake Superior at the rate of about 25 miles a year.

Unfortunately, this growth has come at the expense of the Yellow Perch. Since the appearance of the Ruffe, Duluth/Superior's Yellow Perch population has fallen by an estimated 50 percent.

Yellow Perch are one of the mainstays of commercial fishing on the Great Lakes. They are the most valuable species in Lakes Erie and Ontario, the second most valuable species in Lakes Huron and Michigan, and the most sought after sport fish in the Great Lakes. Obviously, were the Ruffe to spread beyond its current habitat, the economic losses would be severe, perhaps as much as $100 million a year.

Equally important, time was of the essence. The Great Lakes Fishery Commission estimated in 1992 that there was only a 2-year window of opportunity to halt the spread of the Ruffe. If effective measures are not in place by then, the fish would invade the rest of the Great Lakes system.

The Voluntary Ballast Water Management Plan instituted at the beginning of the 1993 navigation season is relatively simple in content and execution. The Plan was prepared in close consultation with U.S. Fish and Wildlife Service. The Plan did not require any retrofitting of vessels or any significant distortions in loading or trading patterns. It was an ideal set of circumstances since Duluth/Superior is primarily a loading out port. Only in certain circumstances is it necessary to take on ballast water in Duluth/Superior. We were operating under the assumption that Great Lakes vessels pumping ballast water onboard could pump onboard live fish which could survive a 36-hour or longer journey. This assumption, while not proven, was considered to be a reasonable possibility.

Basically, the sponsoring shipowners associations received commitments from member fleets to not pump out ballast water taken on in Duluth/Superior or other ports west of a demarcation line that runs between Ontonongan, Michigan, and Grand Portage, Minnesota, once the vessel has passed that

demarcation line. Exchanges of ballast water must be performed at least 5 miles off the south shore of Lake Superior in water at least 120 feet deep. If for some reason the ballast water exchange has not been completed by the time the vessel reaches the demarcation line, it can continue only if the ship is at least 15 miles off shore and in waters at least 240 feet deep. Ballast exchange in extremely deep and cold water is acceptable to the U.S. Fish and Wildlife Service as the Ruffe does not appear to colonize in this environment.

I should note that the United States Coast Guard has also instituted a mandatory Ballast Water Management Program designed to stop the introduction of other non-indigenous species to the Great Lakes. Starting in 1993, the U.S. Coast Guard has been testing the ballast water on ocean-going vessels as they enter the system at Massena, New York. If the water does not meet certain salinity standards, the ship can be ordered back to the ocean to exchange the fresh water it took on wherever it loaded. There has been at least one instance of the U.S. Coast Guard refusing an ocean-going ship entry to the system because its ballast water did not meet the standards. That vessel was delayed until its tanks were treated with salt.

This U.S. Coast Guard strategy is, and should be, the first line of defense. We must do our best to keep nuisance non-indigenous species out of our waters. Fish, zebra mussels, sea lamprey ... all are blind to national flags. They can thrive in U.S., Canadian, or Mexican waters and migrate at will into inland waters. Once in our waters, we are severely limited in controlling spread. As mentioned above, Duluth/Superior is ideal to control the Ruffe through ballast management. If the Ruffe were in Lake Michigan or Lake Erie, locations where ballast water must be pumped on a vessel, ballast water management would not work.

Is this Voluntary Ballast Water Management Plan for Ruffe working? From a carrier's viewpoint the answer is a resounding "Yes." We have had full compliance from vessel captains, and the Ruffe has not been found outside Western Lake Superior. The Ruffe is far from licked. Ballast water management or ballast water treatment systems are only one element of a triad of necessary actions, once a nuisance species enters our waters. Education and, at times, chemical control of water bodies are also needed.

Since it was in all probability the discharge of ballast water from an ocean-going vessel that introduced the Ruffe to Western Lake Superior, some kind of ballast water management program was a necessary element in the containment plan. However, you must understand ballasting is a essential function of safe vessel operation. When a ship is not carrying cargo (what we in the industry call being "light"), the ballast tanks must be partially or completely filled with water or the ship will not ride low enough in the water to maintain safe steerage, hull stress management, and stability. Ballasting requires taking on vast amounts of water. For the largest U.S.-flag Great Lakes vessels, the ballast tanks have a combined capacity of 14.5 million gallons. Even on the smaller ships, the ballast tanks hold anywhere from 2.5 to 5 million gallons. This water is pumped out as the ship is loaded. If it is pumped out too quickly, the ship will hog, sag, or snap in half from the stresses on the hull.

Simply put then, ballast water carriage and discharge into the navigable waters will have to take place as long as ships are carrying cargo to and from ports throughout the United States and the entire world.

In addition to ballast water management controls, there have been numerous other proposals to control the spread of non-indigenous species thought to be contained in ballast water:

- Discharging ballast water to reception facilities ashore.
- Retaining the ballast water onboard.

- Heating or chemically treating the ballast water.
- Inducing a lethal electrical shock at the intake
- Inducing supersaturation of atmospheric gasses.
- Physically pulverizing entrained organisms
- Disinfecting ballast water with ultraviolet light.
- Depriving ballast water of oxygen.
- Coating ballast tanks with biocides.
- Install smaller intake screens.
- Install filters.
- Repel with sound.
- Carbonate ballast water with carbon dioxide.
- Agitate water after intake.
- Ultrasonic treatment.

Many of these suggestions are impractical from an operational viewpoint. Just given the volumes of water involved (more than 14 million gallons on our largest ships) building retaining facilities ashore or retaining the water on ship is either cost prohibitive or physically impossible. Heating the water would require such expensive retrofitting that the vessel could not economically compete for cargo. The use of chemicals would require approvals that have yet to be granted by the U.S. Environmental Protective Agency and could pose a threat to the ship's crew and shipyard workers.

The problem of ballast water transport of non-indigenous species is worldwide. The United States Coast Guard recently produced a video about this subject to underscore the severity of the problem. Lake Carriers' Association then produced its own educational video designed for the Great Lakes domestic trade audience.

There are ongoing studies to understand the problem. Notably, the U.S. Coast Guard-funded study by Dr. James Carlton, et al, The Role of Shipping in the Introduction of Nonindigenous Aquatic Organisms to the Coastal Waters of the United States (other than the Great Lakes) and an Analysis of Control Options, is under review and should be released soon. The Ruffe Control Committee of the Aquatic Nuisance Species Task Force, Chaired by Tom Busiahn, U.S. Fish and Wildlife Service, has also prepared an excellent paper, Ruffe Control Program. A ballast water management study directed at the Great Lakes and other inland waterways will help fill-in the gap in knowledge on how to minimize spread of nuisance species once found in the internal waters.

The proposed legislation also calls for the identification of technologies and practices for demonstration. This problem must be studied further and a demonstration program is essential. Lake Carriers' Association offers its expertise and vessels to test reasonable ideas and solutions. However, I must caution these Committees to not make a common mistake when dealing with maritime matters. In too many instances, there is a perception that all ships are alike, that all marine environments are similar. What works for a vessel sailing between Amsterdam and New York can have no relation to a ship trading between Duluth/Superior and Cleveland. For example, we on the Great Lakes do not call on harbors brimming with infectious wastes, a very real problem for ships calling at some world ports. The solutions to the transport of nuisance non-indigenous species in ballast water will probably prove as diverse as all the maritime nations of the world.

Thank you.

GJR:GN:mbl
10/22/93

Attachment
Voluntary Ballast Water Management Plan

GREAT LAKES MARITIME INDUSTRY
VOLUNTARY BALLAST WATER MANAGEMENT PLAN
FOR THE CONTROL OF RUFFE IN LAKE SUPERIOR PORTS
1993

Owners and operators of vessels in the domestic and international trade on the Great Lakes recognize their role in assisting the governments of the United States and Canada in controlling the introduction and spread of non-indigenous fish species. We recognize that control must be on many fronts, including ballast water management, chemical control, predatory fish control, and other mechanisms. Vessels must use ballast water for safety purposes to provide adequate stability, trim, propulsion, maneuverability, and hull stress control. Recognizing these constraints, the marine industry will do everything within its power, consistent with safety and stability, to decrease the spread of known unwanted non-indigenous species. The introduction of new species from outside the system is under the control of the U. S. and Canadian Coast Guards through ballast water exchange regulations prior to entry into the system. This plan deals with the control of the spread of the European Ruffe from Western Lake Superior ports, in particular, Duluth/Superior or other harbors where Ruffe colonies are documented.

FOR VESSELS DEPARTING LAKE SUPERIOR PORTS *WEST* OF BALLAST DEMARCATION LINE:

1) Operators of vessels pumping ballast water onboard in the above harbors, with ballast line intakes equipped with screens fitted with holes larger than ½" in diameter, are restricted at all times of the year in their pumping out of ballast water from these harbors into the Great Lakes or their Connecting Channels or harbors. This ballast water should be pumped out west of a ballast demarcation line between Ontonagon, Michigan and Grand Portage, Minnesota. Ballast water from these harbors must not be pumped out within 5 miles of the south shore of Lake Superior while west of the ballast demarcation line. Ballast exchange should take place in water at least 20 fathoms (120 feet) deep.

2) Operators of vessels pumping ballast water onboard in the above harbors, with ballast line intakes equipped with screens fitted with holes ½" in diameter or less, are restricted only during the period between May 15 and September 15 in their pumping out of ballast water from these harbors into the Great Lakes or their Connecting Channels or harbors. During this 4-month period, these vessels should pump out the harbor ballast water west of a ballast demarcation line between Ontonagon, Michigan and Grand Portage, Minnesota. Harbor ballast water must not be pumped out within 5 miles of the south shore of Lake Superior while west of the ballast demarcation line. Ballast exchange should take place in water at least 20 fathoms (120 feet) deep.

3) If ballast exchange is not completed at the time the vessel reaches the demarcation line, exchange may continue in Lake Superior, but only in waters at least 40 fathoms (240 feet deep) and 15 miles from shore. In all cases, exchange must stop before proceeding east of 86° west.

FOR VESSELS DEPARTING LAKE SUPERIOR PORTS *EAST* OF BALLAST DEMARCATION LINE:

4) Vessels departing Thunder Bay should limit pumping ballast onboard as in paragraphs 1) and 2) above. These vessels may exchange ballast in Lake Superior, but only in waters at least 40 fathoms (240 feet deep) and 15 miles from shore. In all cases, exchange must stop before proceeding east of 86° west.

FOR *ALL* VESSELS DEPARTING LAKE SUPERIOR PORTS:

5) Operators of vessels pumping in ballast water from the above harbors and leaving the harbor with that water will maintain a record showing the amount of ballast water taken, the means of control, if any, and the location where the treated or untreated harbor ballast water was pumped out.

6) The ballast water records will be available for review by U.S. or Canadian Coast Guard personnel.

7) The above requirements will be waived for vessels which attest by means of a log entry that the harbor ballast water from the above harbors will not be pumped out within the Great Lakes/St. Lawrence Seaway System (at least until reaching salt water). Masters of these vessels recognize that ballast water from the above harbors must not be pumped out in any other fresh or brackish water port and thus should exchange ballast with salt water.

VOLUNTARY BALLAST WATER MANAGEMENT PLAN CO-SPONSORED BY:
- Canadian Shipowners Association
- Lake Carriers' Association
- The Thunder Bay Harbour Commission
- Seaway Port Authority of Duluth
- Shipping Federation of Canada
- U.S. Great Lakes Shipping Association

10/02/93

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DEPARTMENT OF TRANSPORTATION

U.S. COAST GUARD

STATEMENT OF CAPTAIN MICHAEL J. DONOHOE

ON BALLAST WATER EXCHANGE

BEFORE THE

SUBCOMMITTEES ON FISHERIES MANAGEMENT,

MERCHANT MARINE, AND COAST GUARD AND NAVIGATION

HOUSE MERCHANT MARINE AND FISHERIES

HOUSE OF REPRESENTATIVES

OCTOBER 27, 1993

CAPTAIN MICHAEL J. DONOHOE
U.S. COAST GUARD

Captain Donohoe is presently serving as the Chief, Marine Environmental Protection Division, Coast Guard Headquarters, Washington, DC, where he is the manager for the Coast Guard's Marine Environmental Protection Program, and heading the primary office charged with implementing the Oil Pollution Act of 1990. He has had a variety of operational and staff assignments in his 20-year career. After graduation from Wheeling College in 1971 he entered Officer Candidate Training and was commissioned in January 1972. Captain Donohoe was initially assigned to Coast Guard Group Mobile, Alabama as Assistant Operations and Port Safety Officer, followed by assignments as Executive Officer of the National Strike Force's Gulf Strike Team, Executive Officer of MSO Louisville, Graduate School, a tour on the Planning Staff of the Chief, Office of Merchant Marine Safety, a Program Reviewer in the Office of the Chief of Staff, and the Commanding Officer of MSO Memphis, Tennessee.

Captain Donohoe was awarded a Master of Public Administration Degree from Harvard University in 1983. His military decorations include 2 Meritorious Service Medals, Five Coast Guard Commendation Medals, and 1 Coast Guard Achievement Medal, all with operational distinguishing devices. He was awarded the Southwest Asia Service and Kuwaiti Liberation Medal for service in responding to the DESERT STORM Oil Spill during the Persian Gulf war.

He is married, has 5 children, and wishes he had more time for running and returning phone calls.

STATEMENT OF CAPTAIN MICHAEL J. DONOHOE
U. S. COAST GUARD
BEFORE THE
SUBCOMMITTEES ON FISHERIES MANAGEMENT,
MERCHANT MARINE, AND COAST GUARD AND NAVIGATION
HOUSE MERCHANT MARINE AND FISHERIES
HOUSE OF REPRESENTATIVES
OCTOBER 27, 1993

Good morning Mr. Chairmen and distinguished members of the Subcommittees. I am Captain Michael J. Donohoe, Chief of the Marine Environmental Protection Division within the Office of Marine Safety, Security, and Environmental Protection. Thank you for this opportunity to discuss the issue of ballast water management and the Coast Guard's efforts to stop the future introduction of nonindigenous aquatic nuisance species.

I would like to first give you some background on the Coast Guard's role to date in the nonindigenous aquatic nuisance species prevention effort, and then discuss efforts we are taking to further strengthen this vital prevention program.

THE COAST GUARD'S ROLE

The Coast Guard's role in preventing further introductions of nonindigenous aquatic species is varied. The Coast Guard is the agency responsible for enforcing the provisions of the Nonindigenous Aquatic Nuisance Prevention and Control Act (16 U.S.C. 4701 et seq.)(the Act) and Coast Guard representatives serve on a variety of Aquatic Nuisance Species Task Force committees. Additionally the Coast Guard has focused

international attention on the aquatic nuisance species problem through its representation at the International Maritime Organization (IMO) and direct interaction with foreign nations seeking to deal with the problem. The Coast Guard has conducted a number of studies mandated by the Act and is assisting state governments in their efforts to deal with the aquatic nuisance problem.

AQUATIC NUISANCE SPECIES TASK FORCE PARTICIPATION

The Coast Guard is a permanent member of the Aquatic Nuisance Species Task Force, set up by the Act to coordinate scientific efforts to prevent and control the spread of aquatic nuisance species. Additionally, the Coast Guard has representatives on a number of Task Force committees such as the Program Committee, the Zebra Mussel Coordinating Committee, the Monitoring Committee, the Ruffe Control Committee, and the Risk Committee. Recently, the Program Committee has just presented the final draft of the Aquatic Nuisance Species Program which will become the basis of all future Task Force efforts. The Coast Guard is encouraged by the work of these committees and believes this interagency effort to thwart the spread of aquatic nuisance species is critical to the success of this program in the United States.

VOLUNTARY AND REGULATORY INITIATIVES

The Act stipulates that the Coast Guard regulate the discharge of ballast water from ships entering the Great Lakes which have operated outside the Exclusive Economic Zone (EEZ) of both the United States and Canada. The Act specified that guidelines be issued within 6 months of its enactment and that an educational program be conducted as a prelude to mandatory regulations.

The U. S. Coast Guard's excellent working relationship with the Canadian Coast Guard and Environment Canada greatly facilitated the development of joint voluntary guidelines that were published in March 1991. These voluntary guidelines asked all vessels entering the St. Lawrence Seaway, coming from a foreign port, to exchange their ballast water in deep ocean. They further requested that mariners provide documentation of where this exchange had taken place and where the ballast had been taken aboard. Ballast water exchange was chosen as the primary means of managing ballast, as other techniques were, and still are today, largely unproven or costly to implement.

Compliance with these voluntary guidelines exceeded all expectations. It was estimated that within a year there was a 85-90% compliance rate. At the same time that these guidelines were being encouraged, the Coast Guard implemented an education program for mariners on the problems of aquatic nuisance species introduction. This program, developed by a Coast Guard graduate

student at the University of Michigan, has been highly successful and continues to be a key component to the Coast Guard program. The education program is discussed in detail later in this testimony.

The Coast Guard realized that to conduct an educational program effectively, and enforce regulations mandating ballast water management, additional resources would be needed. These resources were provided by Congress and in 1992 the Coast Guard opened a Marine Safety Detachment at Massena, New York. Massena was chosen as it is the first United States port on the St. Lawrence Seaway. In 1992, this unit conducted boardings to check for compliance with the voluntary guidelines and to educate mariners on the aquatic nuisance problem.

On May 10, 1993, the Federal regulations mandated by the Act replaced the voluntary guidelines. These regulations require ballast water management for ships bound for a United States port on the Great Lakes that have operated outside of the EEZ. Since Massena, New York is considered a United States port, all vessels are subject to the regulations when they reach this point on the Seaway. Additionally, the voluntary guidelines are still in effect for those vessels going to Canadian ports before they reach Massena, and Canada continues to actively encourage compliance and is working closely with the United States to implement a unified prevention strategy.

The regulations allow various compliance alternatives. Vessels must manage ballast in one of four ways: exchange their ballast in deep ocean in order to flush out the ballast tanks and introduce a salinity level that should be incompatible with organisms taken on in fresh water; retain their ballast water on board while in the Great Lakes; discharge ballast water to a reception facility; or use an approved alternative method. Furthermore, these vessels must record where they exchange their ballast, the original source of the ballast, and where they will discharge the exchanged ballast. To be in compliance, exchanged ballast water must have a minimum salinity level of 30 parts per thousand. Realistically, the only method of ballast water management currently available to vessels entering the Great Lakes is ballast water exchange. There are no reception facilities yet available and vessels must discharge ballast as part of normal cargo operations. In developing the regulations, the Coast Guard recognized that ballast water exchange may not be 100% effective and that innovative methods of ballast water management should be encouraged. This is the concept which provides the rationale for allowing alternative methods that have been previously approved by the Guard.

Since the promulgation of the original regulations, the Act has been amended to require ballast water management for vessels entering the Hudson River north of the George Washington Bridge. These regulations are currently under development and will be in place by the November 1994 deadline.

The Coast Guard was able to develop timely, effective regulations because of a strong legislative mandate and sufficient resources to implement the provisions of the Act. However, the absence of clear alternatives to ballast water exchange, and a lack of resources to develop a scientific evaluation program remain shortcomings of this mission.

Industry response to these regulations has been outstanding. To date, there have been only two instances where vessels were not in full compliance with the regulations. In both cases, vessel operators made good faith attempts to comply, but the required salinity level was not achieved. While always ready to use our enforcement authority if necessary, the Coast Guard understands the delicate balance between protecting the environment and facilitating commerce. With this in mind, the Coast Guard worked with industry representatives to develop procedures that the aforementioned two vessels could use to bring themselves into compliance. In one instance, salt was added to ballast tanks to bring the salinity to an acceptable level, and in the other case the vessel used heat to treat the ballast water before discharge.

The shipping industry on the Great Lakes has been proactive rather than reactive. One particular problem within the Great Lakes is the movement of the European Ruffe from one area to another. In order to contain the Ruffe, the Great Lakes Shipping Association, with Coast Guard assistance, developed guidelines

and educational material for its members. Their participation has been outstanding and is an excellent example of the industry's responsiveness to the problem.

INTERNATIONAL EFFORTS

From its earliest involvement in the nonindigenous aquatic nuisance issue, the Coast Guard has been a part of the international effort necessary to effectively prevent unwanted introductions of aquatic species. The Australians were the first to sound the alarm in the international community, followed soon thereafter by Canada. Australia issued voluntary guidelines and asked the other maritime nations to consider them. These guidelines were followed closely by Canadian guidelines and then joint Canadian/United States guidelines. There were no other international standards for ballast water management, however. Through the urging of Australia, Canada, and the United States, the Marine Environment Protection Committee of the International Maritime Organization (IMO) adopted voluntary ballast water management guidelines in July 1991 as Resolution MEPC.50(31). These guidelines are closely based on the voluntary efforts that were in use at the time by the United States, Canada, and Australia. They call for member nations to request that their ships follow ballast water management practices and they ask any state that should implement mandatory regulations to do so based on the guidelines. To date, the United States is the only nation to have mandatory ballast water management and in developing the

regulations, the United States closely followed the IMO guidelines.

Since 1991, the issue has taken on additional importance within IMO. A working group, of which the United States is a member, is currently looking at ballast water management as a possible new annex to the MARPOL convention. Additionally, the Coast Guard is working with other Federal agencies and their counterparts in other nations to develop an international symposium to be held on the issue of aquatic nuisance species introduction.

NATIONAL EFFORTS BEYOND THE GREAT LAKES AND HUDSON RIVER

While the Coast Guard only has ballast water enforcement authority over vessels entering the Great Lakes, it has been actively involved in nationwide efforts to reduce the introduction of aquatic nuisance species and pathogens. In July 1991, cholera was discovered in shellfish in Mobile Bay, Alabama. Ballast water was identified as a possible pathway for introduction of this bacteria and a sampling program was initiated by the Food and Drug Administration. The Coast Guard facilitated the boarding of ships by FDA inspectors in 10 U.S. ports to check ballast water for the cholera strain. Two ships, whose last port of call was in South America, were identified as carrying the strain, and were not allowed to discharge ballast. Additionally, the Coast Guard, through the Department of State, notified the next port of call for these vessels so the

contamination could be monitored. While no additional cholera was found and the shellfish beds are clear of the bacteria, the Coast Guard will continue to assist in this effort. In an effort to prevent a recurrence of this type of introduction, without having ballast water enforcement authority outside of the Great Lakes, the Coast Guard published the IMO ballast water guidelines in the Federal Register and asked for voluntary compliance by vessels coming to the United States. The Coast Guard is aware of at least one major shipping line that changed its procedures to conform with the guidelines.

A number of states have expressed interest in ballast water management and the Coast Guard has provided assistance to the states of Alaska, California, Maryland, and Washington. The State of California passed a requirement that vessels entering ports in California maintain records of where they took on ballast. The Coast Guard is assisting state authorities in identifying the proper methods to secure this information using existing resources.

In addition to assisting state governments, the Coast Guard is participating in a number of scientific efforts to identify and control aquatic nuisance species. The Ninth Coast Guard District is working closely with environmental and industry groups to foster compliance and understanding of the problem in that region. The Coast Guard participates in the Zebra Mussel monitoring program, administrated by the Fish and Wildlife

Service, which seeks to track the spread of this nuisance species. This is primarily the responsibility of the Coast Guard's Aids to Navigation teams who check buoys and other aids during routine maintenance to see if Zebra Mussels are attached. The Coast Guard has no statutory authority to prescribe regulations in areas of the United States, other than the Great Lakes and Hudson River. The Coast Guard believes that incidents such as the cholera episode in Mobile Bay and the discovery of nonindigenous aquatic species nationwide give impetus to the discussion of whether or not regulations, or a nationwide program of voluntary ballast water management, should be in place.

EDUCATIONAL EFFORTS

As previously mentioned, the Coast Guard has been conducting a ballast water management education program for the last two years. This program consists of written, audiovisual and lecture materials. A video, specially produced for the Coast Guard, in both VHS and international formats, illustrates the problems and history of aquatic nuisance species introduction, and outlines the proper methods to exchange ballast water. Additionally, a brochure was developed to complement the video that gives specific instructions for the Great Lakes. This material is given to each vessel that is inbound through the St. Lawrence Seaway. A similar brochure is under development for the Hudson River and will be available soon. Copies of both the video and brochure have been provided to the committee.

Recently, the Coast Guard has been approached by the Smithsonian Institution to assist in developing a module on the aquatic nuisance threat for an upcoming exhibit on "Oceans in Peril". The Coast Guard welcomes this opportunity and is providing educational materials and expertise.

THE SHIPPING STUDY

The Nonindigenous Aquatic Nuisance Prevention and Control Act required the Coast Guard to conduct a Shipping Study to explore the impact of shipping on the introduction of ballast water into ports other than on the Great Lakes. Conducted under the direction of Dr. James Carlton of Williams College, Mystic, Connecticut, this 400 plus page report identifies ports that may be at risk from aquatic nuisance species being transported by ballast water. The report also recommends possible control options. The report estimates that 11,507,000,000 gallons of ballast water arrived in United States ports in 1991 with New Orleans receiving the highest amount of total ballast. Virtually all U.S. ports receive ballast water from throughout the world and northern Europe and the Pacific rim are the major contributors. The report is currently in agency clearance in preparation for forwarding to Congress.

ALTERNATIVES TO BALLAST WATER EXCHANGE

A vessel uses ballast to offset the distribution and weight of cargo which is critical to the vessel's stability and safety. In virtually every cargo operation, ballast must be either taken on or discharged. Therefore, the management of ballast is critical to compliance.

From its earliest involvement, the Coast Guard has realized that ballast water exchange is not the end-all solution for ballast water management. There are numerous problems associated with ballast water exchange and its effectiveness is only as reliable as the efforts put forth by the vessel. Other technical methods must be explored as alternatives for exchange so that vessels have a variety of methods available to them to comply with voluntary and regulatory efforts to prevent the spread of nonindigenous aquatic nuisance species.

Ballast water exchange seeks to flush out organisms and replace the water with deep ocean water that should contain few, if any organisms which can strive in freshwater. Currently, there is a reliance on the high salinity level of ocean water to help destroy freshwater organisms. While this is effective for freshwater areas like the Great Lakes, high salinity levels will have little or no effect on organisms taken on and discharged into salt or brackish water. Additionally, even though ballast water may be exchanged, sediment remains in the bottom of all ballast tanks and may harbor and protect organisms from the flushing action of the exchange. This sediment is virtually

impossible to remove while the vessel is underway, and thus poses an additional environmental threat. These properties clearly indicate a long term need for alternative methods.

There are also questions of safety concerning ballast water exchange. When a vessel is exchanging ballast water, it may become "light" and therefore susceptible to factors of wind, waves, tide, and current. Additionally, ballast exchange puts a strain on the hull and systems of a vessel, that over time may create hazards to vessel operations such as the weakening of structural members through flexing. While this is not a great problem for the smaller vessels, there is no firm data on the effect of ballast water exchange on larger vessels such as large container ships and tankers.

The Coast Guard believes that it is imperative that other methods of ballast water management be developed, evaluated, and made available as alternatives to exchange. A number of these have already been identified as possible choices. They include processing of the ballast water through filters to prevent the passage of organisms, discharge to a reception facility, ultraviolet light treatment, heat treatment, and the use of chemical additives. Most if not all of these alternatives will require some type of retrofitting to vessels.

Discharging to a reception facility, while sounding simple, may not be a particularly viable option at this time. There

currently are no such facilities in the United States and most vessels are not equipped to discharge ballast water to a shore facility without retrofitting of piping. Other methods such as ultraviolet light and chemical treatment, while possibly effective, may have negative effects on the environment. We hope that all methods are evaluated and that new technical ideas, not yet considered, are developed.

The Coast Guard allowed for alternatives in the development of its regulations. However, the Coast Guard does not have sufficient scientific resources to evaluate alternatives for their effectiveness. The Coast Guard encourages the formation of a committee or task force, made up of representatives from the Federal government, industry, and the scientific community, with sufficient funding to evaluate alternatives. This committee could then advise the Coast Guard on effective alternative methods to exchange and identify the criteria under which they should be utilized.

The Coast Guard has begun working through a voluntary consensus standards organization to assess the technical nature of the nonindigenous species problem and develop technical standards for addressing it. Within the American Society Testing and Measurement (ASTM) Committee F25 on Ships and Marine Technology, task groups will collect information and develop and propose standards for controlling the introduction of nonindigenous species through a variety of mechanisms, in consideration of

physical, chemical, and biological parameters. ASTM leverages private and public sector assets in a professional forum building technical consensus for solving problems. We recognize the process of developing consensus standards is a slow one but I assure the committee that the Coast Guard will actively participate in the process, provide leadership, and ensure that effective standards are developed for national and international application.

SUMMARY

In summary, the Coast Guard stands ready to assist the any agency or private group, in the development of effective ballast water alternatives. Additionally, the Coast Guard is committed to being a full participant in the effort to reduce or prevent the future introduction and spread of nonindigenous aquatic nuisance species into the waters of the United States. This concludes my testimony -- I will be happy to answer your questions at this time.

DEPARTMENT OF TRANSPORTATION
MARITIME ADMINISTRATION

STATEMENT OF MARC P. LASKY
CHIEF, DIVISION OF NAVAL ARCHITECTURE
OFFICE OF THE ASSOCIATE ADMINISTRATOR
FOR SHIPBUILDING AND SHIP OPERATIONS

BEFORE THE SUBCOMMITTEE ON MERCHANT MARINE,
THE SUBCOMMITTEE ON FISHERIES MANAGEMENT, AND
THE SUBCOMMITTEE ON COAST GUARD AND NAVIGATION

U.S. HOUSE OF REPRESENTATIVES

ON THE BALLAST WATER CONTROL ACT

OCTOBER 27, 1993

Mr. Chairman, members of the Subcommittees, my name is Marc P. Lasky and I am the Chief of the Division of Naval Architecture in the Office of the Associate Administrator for Shipbuilding and Ship Operations at the Maritime Administration. I appreciate your invitation to testify on behalf of the Maritime Administration concerning H.R. , the Ballast Water Control Act.

Ballast water from vessels provides a viable in-transit habitat for a wide variety of marine organisms. Invasive nonindigenous species continue to enter, spread and cause economic and environmental harm. Some escape detection at ports-of-entry, and ordinary quarantines appear unable to contain them because we lack sufficient scientific knowledge and detection technologies to address the problem. The uncontrolled discharge of ballast

water is a major international problem that can be expected to worsen, and a satisfactory long term solution to the problem is needed. We especially recognize how important a solution to this problem is to the Great Lakes.

The Maritime Administration supports the goals of this legislation, including further study and demonstration. This effort could be considered by the International Maritime Organization and Coast Guard for future management of the discharge of ballast water containing harmful aquatic organisms. In an effort to assist the Coast Guard in carrying out the requirements of H.R. ____, we believe that concerned federal agencies should co-sponsor an assessment of various technologies available or under development for the control and treatment of harmful aquatic organisms in ballast water. This assessment could be followed by a demonstration project of one or more of the promising technologies, as required by the bill.

In order to make the best use of limited research and development funds, MARAD currently conducts small scale research programs in a number of broad program areas, in cooperation with other Federal agencies and private industry. For example, the Maritime Operational Safety Program works for advanced vessel navigation and communication systems, operational procedures, and maintenance policies that enhance maritime safety. Projects under this program are selected jointly with the National

Transportation Safety Board and the U.S. Coast Guard. Of particular relevance is the Small Business Innovation Research Program, which encourages small businesses to develop innovative solutions to Government and industry problems. Projects under this program address human factors, environmental protection, and improvements in terminal, cargo and ship operations. The program is administered by the Department's Volpe National Transportation Systems Center, with both Coast Guard and MARAD participation.

MARAD could also assist the Coast Guard, in conjunction with other concerned Federal agencies and private industry, in cooperatively administering and providing technical expertise for one or more of any funded demonstrations required by the Ballast Control Act under such a program, beginning in FY 1995.

Additionally, MARAD has experience in the area of ship construction and operation, and a good understanding of the shipping industry. MARAD has prepared ship designs for both new construction and conversion, including ship stability, loading, piping, machinery plant and the economic viability of projects. This experience would be germane to the implementation of a funded ballast water exchange ship demonstration project.

MARAD's participation in a demonstration program could also help provide an interface between the scientific community and the "real world" of the maritime industry. This interface could help

insure that the technologies selected as most promising from a scientific point of view are workable and can be economically and efficiently used in the commercial merchant fleet. For example, MARAD recently provided technical expertise to the Coast Guard in its effort to provide regulations required by the Oil Pollution Act of 1990. We are currently working with the Navy on the conversion of National Defense Reserve Fleet containerships and tankers to auxiliary crane ships and off-shore petroleum discharge systems, and are assisting NOAA, on an ad-hoc basis, with their fleet replacement program.

In conclusion, we believe that the bill provides a realistic time frame for the submission of required reports on the completion of a study, and on findings and recommendations resulting from a demonstration project. It is our understanding that the funds necessary for the scientific study and demonstration project would need to be provided.

Mr. Chairman, this concludes my statement. I will be happy to answer any questions that you or any Subcommittee members may have.

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